



INTERNATIONAL INSTITUTE OF AGRICULTURE  
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

## INTERNATIONAL REVIEW OF THE SCIENCE AND PRACTICE OF AGRICULTURE

MONTHLY BULLETIN  
OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

### FIRST PART. ORIGINAL ARTICLES

#### **Mechanical Ploughing. Handling of the Machines.**

BY

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At present the use of machinery for ploughing is spreading so rapidly, especially in France, Great Britain and Italy, that it will be necessary to modify the usual methods of cultivating the soil in such a way as to utilise the machines in the best possible manner.

This modification is all the more necessary in Italy since the greater number of the machines had to be hastily — and consequently not always so carefully as was desirable — ordered from the United States, a country having different soil conditions and methods of cultivation, as well as of purchase and use of the machines.

Unfortunately, on the contrary, many farmers, obstinately clinging to the old customs or slaves of routine, thought they could simply use the machine to replace the ordinary plough, thus obtaining an unsatisfactory yield of work, imperfect ploughing, and sometimes running the risk of having unpleasant surprises while the work was in progress.

However, it must be admitted that, though much progress has been made in the construction of machines for motorculture, and though there is an abundance of publications dealing with the subject, yet very little attention has been paid to practical instruction on their application to the soil, except for a few publications by experts dealing with special aspects of the vast problem (1) and for pamphlets and catalogues — not always disinterested — published by the makers of such machines.

(1) For example, see the articles by Prof. RINGELMANN in the *Journal d'Agriculture pratique*, 1916, p. 435 and 1917, p. 103.

It is, therefore, not surprising that, owing to lack of more complete and detailed information, farmers are perplexed when about to buy new machines, or are embarrassed when using them on the farm.

The present notes are intended to provide new material for the study of this important question, by considering a series of data and practical rules concerning the new technique of cultivation.

A description will be first given of the handling of the machines in the field, following by a more detailed consideration of the way they should be used in ploughing according to the various methods of preparing the soil.

Leaving aside balance machines (with cable or direct traction), the handling of which is reduced to engaging and lifting out the ploughs at the beginning and end of each furrow, only motor ploughs and tractors will be considered, as their handling is much more complicated, both during the work (ploughs in the soil) or when the ploughs are lifted.

**HANDLING DURING WORK.** — It is very easy to guide the machine during ploughing when the furrow is rectilinear, but it must be very straight. For this reason the first furrow should be turned most carefully with a team, for the perfection and easy working of all the following furrows depends on its straightness.

Handling becomes much more complicated when the furrow is curved. Let us take the example of a tractor with one driving wheel working in the furrow (Fig. 1).

The coupling  $\gamma$ , usually attached at about the middle  $q$  of the back-axle, can turn round this point, describing an arc of radius  $r$  (length of coupling). When the tractor turns, describing an arc of radius  $R$ , the chain and, consequently, the plough-beam, should take up the position  $ax$ , in order that the width ploughed should remain constant. On the contrary, however, owing to the pull being on a curve the chain tends to assume the position  $ac_1$  (normal to  $R_1$ ), so that there is a tendency for the ploughs to be displaced towards the centre  $O$  of the curve.

This tendency, whilst hindering the steering by causing a lateral com-

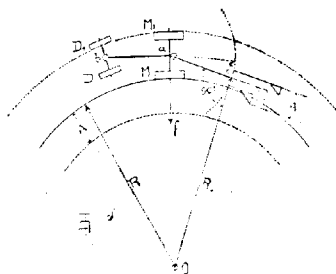


Fig. 1 — Ploughing on a curve with a tractor with one driving wheel running in the furrow.

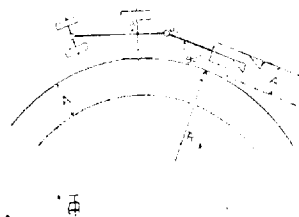


Fig. 2 — Ploughing on a curve with a tractor with one driving wheel; effect of moving the coupling to  $a$ .

ponent  $f$  to act on the driving wheels which causes the rear wheels of the tractor to be displaced transversely to the direction of movement, prevents the ploughing of a uniform width, as the ploughs tend to be displaced towards the ground already ploughed and to enter into the preceding furrows, while the displacement is all the greater as the chain  $r$  is the longer and the turning radius  $R$  is shorter.

When the point where the chain (Fig. 2) is attached is moved to  $a$ , or as far as  $a_{\text{max}}$  (as is done for hauling military lorries on the road), the difficulty is lessened, but not eliminated, for such a displacement should vary with the radius of the curve (1).

This difficulty is also not eliminated when ploughing on an internal curve, i. e., when the driving wheel  $M_1$  runs in the furrow. In this case the ploughs tend to move away from the ploughed land, thus covering a larger width and leaving strips unploughed.

This disadvantage is less noticeable with machines of the MOLINE type (front driving wheel) or with motor-ploughs of the PAVESI-TOLOTTI type.

With machines working, not in the furrow, but on the firm land, there is no difficulty in ploughing external curves, because their freedom of movement on the soil allows of the ploughs being guided into the correct position; on the other hand, the disadvantage is accentuated when working on an internal curve, the steering wheel  $D$  being obliged to run on the ploughed ground.

In any case ploughing curves is always very difficult, and results in a poor yield being obtained from the engine on account of the greater passive resistance, while the machine (even with a differential) wears more owing to the abnormal strain on gears and bearings. Work done on such curves can never be regular or perfect.

It can be easily understood why circular ploughing is often practised in North America (the FELLEBERG method and its modifications) on account of the usually light soils and the fact that a depth greater than 5 to 6 in. is rarely ploughed. The regularity of the work in this case becomes merely a side-issue when compared with the benefit obtained by eliminating turning at the end of the furrows, the ploughing thus being continuous.

But, in Italy the more intensive cultivation, which requires better and deeper ploughing, the more compact soils, and the absence of vast plains, indicate the inadvisability of curvilinear ploughing, which should be reserved for indispensable work such as finishing off the corners of the field.

For example, let us assume that a corner of a field, forming an acute angle (Fig. 3), to take a simple case, has to be finished. It should be finished on a curve of the shortest radius compatible with the turning of the

(1) Theoretically, the constance of the relative positions of the (rigid) coupling and the beam can be obtained for any turn by making them both of the same length, or by using a double (rigid) coupling crossed X-wise. In practice, however, this is not easy, on account of constructional difficulties and even of the ploughing, especially with gang-ploughs.

machine, *i. e.*, along the curve *acb* (shown as an arc to simplify matters) so as to reduce to a minimum the space *Oacb* which has to be left to be finished by hand. But this is not possible because, whether working on internal or external curves there would be unploughed strips on the curves, given that the widths *L* of the first furrow are so much greater than the normal width *l* as the angle of the field is more acute.

The ploughing must, therefore, be done in *concentric* curves (Fig. 4); the part of the angle left untouched will, it is true, be greater, but the rest will be completely and uniformly ploughed.

The attention of the drivers should be drawn to this simple fact, especially when they wish to close the furrows by proceeding from the exterior to the interior of the field (as is done in rice fields where the golden rule is to heap the soil against the banks that surround the field, so as to strengthen them), in order that they may not open the first furrow with the maximum turn, then find that they cannot turn symmetrically on the curves of the subsequent furrows.

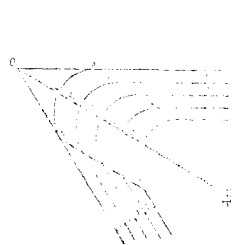


Fig. 3 — Ploughing a corner of a field: bad method.

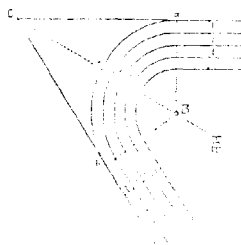


Fig. 4 — Ploughing a corner of a field: good method.

**HANDLING WITH THE PLOUGHS LIFTED.** — Handling with the ploughs lifted is much lighter and easier than during ploughing, but it is much more frequent, particularly when there are short furrows or irregular plots, so they tire the driver the most. From this point of view, they thus deserve special consideration.

Turning is easier with 2 steering wheels mounted on a loose axle, turning like the front-wheels of an ordinary four-wheeled cart. It is less easy when the 2 wheels are turned as in the automobile type, and still less easy when there is only one steering wheel. In the last two cases turning on the spot is very tiring if the tyres of the wheels are very prominent and it is almost impossible on very compact soils.

The turning should, therefore, be done while moving, and gradually, without pushing the turn to the maximum, for handling is nearly always more tiring on narrow curves; but, on the other hand, it should be done energetically and quickly so as to save time (thus obtaining more work

and a smaller consumption of fuel) and space (smaller breadth of the headlands).

It is thus of interest to see how the machine can be handled in the field, while conciliating the opposite requirements of less fatigue with greater speed, in the narrowest space.

When it is said that a machine *turns* in a radius, of 5 metres for example, it means that the machine can, at the maximum, turn in a circle of 10 metres in diameter, but not that it could do the whole turn in a space of 10 metres except by doing the maximum turn *on the spot*, which never happens in practice.

For example, take a machine moving along a straight line *AB* (Fig. 5) and which, when at *B*, should turn to the right. The driver, letting the machine move forward, commences to turn gradually towards *C*, the maximum turning point, after which the machine would advance automatically, describing an infinite number of circles of centre *O* and radius *OC* corresponding to the minimum possible to the machine. The trajectory *BC* of the machine is evidently a polar curve, for, supposing that the turning could increase still more after the point *C*, the radius of curvature would be reduced to zero, *i. e.*, would attain the pole; the amplitude or development of the trajectory in the field depends, for the abscissae *BD* and the ordinates *CD*, on the ratio between the two speeds of advancing and turning (1) simultaneously.

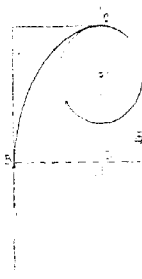


Fig. 5.—Mathematical analysis of a turn.

If this ratio is constant, *i. e.*, if the machine moves forward uniformly and if it turns gradually, as in the cases when it would be obtained mechanically with a uniform movement, then the curve has a well defined equation: that of the logarithmic spiral, as is shown by the mathematical analysis.

Figures 6 to 16 represent by one of these spirals (the same in each figure, and on the same scale), a few of the commonest evolutions carried out in the field by tractor ploughs (usually with ploughs turning the earth on one side only), in order to compare the length covered (space covered as a function of time employed, and, consequently, of fuel consumed) and the total amplitude of the turnings (sum of work or effort expended by the driver).

These figures show the form of the evolutions, *carried out with constant speed in the minimum space*, given: — *a*) the maximum width of a headland, or the space in which the evolutions must take place included between the lines *xx* (end of the furrows) and *yy* (edge of the field) (Fig. 6); *b*) as unit *P* of effort, making a complete turn (to pass from *B* to *C*, Fig. 5);

(1) In Fig. 5, *B* is a point of the curve placed so that the tangents at *B* and *C* are normal to one another; this is an example of one of the commonest practical applications. But *B* could also be placed either above or below the line *BD*.

c) as unit  $S$  of space, the corresponding trajectory, that is, the length of the spiral  $B C$ .

*Minimum turn with curve of  $180^\circ$ , or half-circle turn (Fig. 6).* — When the last plough is about to reach the line  $xx$  at  $A$  (end of furrows) the steering wheels have reached  $B$ , where the turn to the right, for example, commences. Once the maximum turn has been reached at  $C$ , the driver begins to turn to the left until the machine reaches  $D$ , afterwards starting the return trip at  $A_1$ . *Total journey* =  $2 S$ ; *total work* =  $2 P$ .

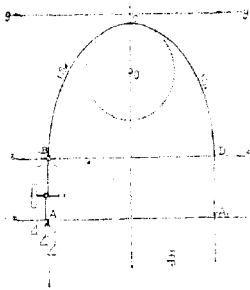


Fig. 6 — Minimum turn at  $180^\circ$

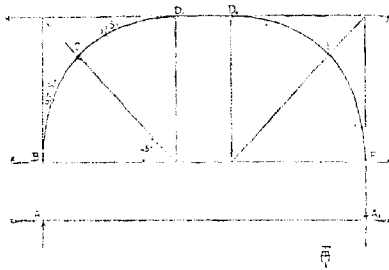


Fig. 7 — Minimum turn at  $90^\circ$  repeated.

*Minimum turn with curve of  $90^\circ$  (Fig. 7).* — To reach half the turn (angle of  $45^\circ$ ) at  $C$  the machine had to turn about  $\frac{1}{4}$  to the right, travelling a distance of  $0.7 \times S$ ; it has to turn the same distance to arrive at  $D$ . *Total journey* =  $1.4 S$ ; *total work* =  $1.4 P$ . This turn usually serves to fix the breadth of the chief headland.

If it is desired to return to the furrows (turn of  $180^\circ$ ) from  $D$  (or from

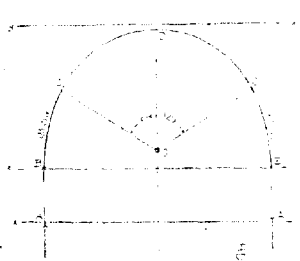


Fig. 8 — Circle of  $180^\circ$  with minimum turn.

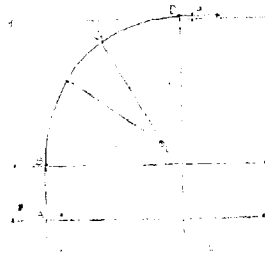


Fig. 9 — Manoeuvre for decreasing the turning.

$D_1$ , after a rectilinear journey along the edge of the field), the same manœuvre must be repeated, i. e., that  $D_1E$  = about  $\frac{3}{4}$  of the right-hand turn, and  $E F$  = about  $\frac{3}{4}$  of the left-hand turn. *Total journey* =  $2.8 S + DD_1$ ; *total work* =  $2.8 P$ .

*Curve of 180° with minimum turn* (Fig. 8). — From  $B$  to  $C$ , half-turn

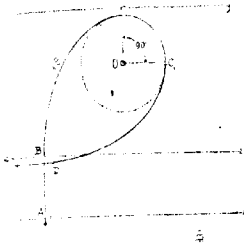


Fig. 10 — Orthogonal turn.

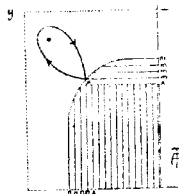


Fig. 11 — Finishing work on a curve of two headlands with orthogonal turns.



Fig. 12 — Method of ploughing without headlands, eliminating orthogonal turns.

to right; from  $C$  to  $C_1$ , arc of circle (without turning manœuvre) of centre  $O$ , angle about  $120^\circ$  and length about  $1.75 S$ ; from  $C_1$  to  $E$ , half-turn to right to straighten out. *Total journey* =  $2.75 S$ ; *total work* =  $1 P$  (1).

These results show that the turns should be kept within the limits of Figs. 6 and 8 (i. e., between 5 and 8 metres with the ordinary American

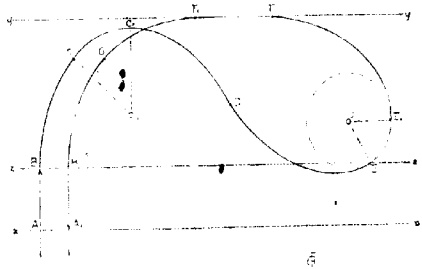


Fig. 13 — Double turn within the breadth of an ordinary headland.

machines) and that it is a mistake to think that very wide ridges (as in Fig. 7) save the driver trouble; he certainly has an period of rest (in the journey  $DD_1$ ) but there is waste of both time and fuel, while the fatigue caused

(1) In the case of Fig. 7, the turning curve can be diminished as shown in Fig. 9, but a wider headland will be required (by the quantity  $a$ ). In this case, for a curve of  $60^\circ$  or  $180^\circ$ , where are the values: *Total journey* =  $1.5 S$ , or  $3S + DD_1$ ; *total work* =  $1 P$  or  $2 P$ .



by each evolution is, on the contrary, greater than that resulting from narrower, or at least equal, turns. Moreover, the repeated passage of the wheels over the length  $DD_1$  damages the soil so much that there is very poor grip when turning the last furrows on the edge of the field.

*Orthogonal Turn or at  $270^\circ$*  (Fig. 10). — From  $B$  to  $C$ , complete turn to the right; from  $C$  to  $C_1$ , without a manœuvre, a quarter circle with the smallest turning radius  $OC$ ; from  $C_1$  to  $D$ , complete turn to the left. *Total journey* = 2.5  $S$ ; *total work* = 2  $P$ .

This manœuvre, useful for hauling mowers or harvesters, is recommended by several authors for ploughing also, for preparing the finishing curves at the headland (Fig. 4), turning the head furrows  $m, m, m, \dots$  and the side furrows  $n, n, n, \dots$  which permits of shortening the furrows by diminishing the work on the curve (Fig. 11). But it is advisable: — 1) either to eliminate these difficult orthogonal turns, by arranging that the first furrow should end in  $M$  (Fig. 12) from the beginning of normal ploughing and that the subsequent furrows should be gradually prolonged until they describe the curve  $MN$  suitable for turning the machine; 2) or to replace the orthogonal turns by figure-of-8 turns (described later) limited to the chief headlands when they must be reduced to the same breadth as the side headlands.

*Double or figure-of-8 turns* (Figs. 13, 14, 15, 16). — These are necessary (if the machine has no reverse, or if, having one, the coupling to the ploughs is not rigid) when the machine has to turn in a space narrower than  $BD$  of Fig. 6 (i. e., usually less than 6 metres), as when the first furrow is being opened or the ploughing finished.

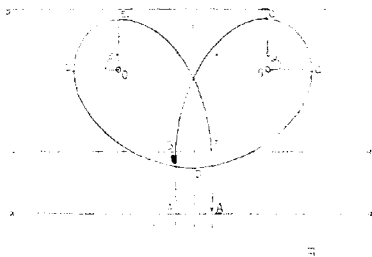


Fig. 14 — Another example of a double turn within the headland, symmetrical to the axis of the furrows.

Figures 13 and 14 give examples of two double turns in the limits of breadth of the ordinary headland. That of Fig. 13 is longer and more difficult, as it requires: *Total journey* = about 6.15  $S$  and *total work* = 4.5  $P$ , while the turn in Fig. 14 requires: *Total journey* = 5  $S$  and *total work* = 4  $P$  and it is easier to carry out, being symmetrical to the axis of the furrows.

Figures 15 and 16 show two double turns inside the field, with no head-

land, as in ploughing without ridges or by the Fellenberg method. The turn of Fig. 15 is symmetrical to the axis of the furrows but is much longer than that of Fig. 16. The respective values are : — *Total journey* = 6.75 *S* and 3.8 *S* ; *total work* 3 *P*.

The various evolutions illustrated by these figures illustrate special problems, for, in practice, freedom in turning allows the driver to enlarge or diminish the curve of the turns at will by decreasing or increasing the turning speed, but the relation of the journey and especially of the total work remains practically the same.

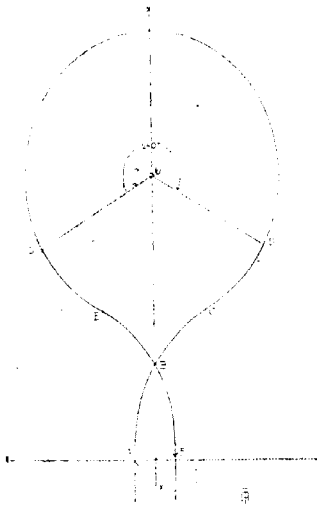


Fig. 15 — Double turn inside the field, symmetrical to the axis of the furrows.

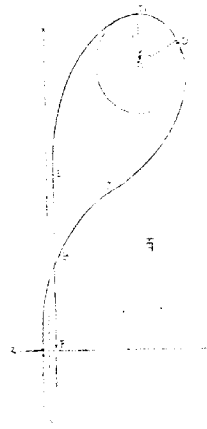


Fig. 16 — Double turn inside the field, not symmetrical to the axis of the furrows and shorter than that of Fig. 15.

This is why, when buying a ploughing machine, it is very important to study and observe its behaviour in the field, by means of repeated turning trials on the field with the ploughs lifted, not only with the object of exercising the driver and making the turns more exact and sure, but also on account of the need for arranging the division of the field and even the choice of the methods of ploughing so as to suit the type of machine.

SECOND PART  
ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

832 - **The Agricultural Development of the East Coast of Sumatra.** — BLINK, H., in the *Tydschrift voor Economische Geographie*, Nos. 3 and 4, pp. 109 + Figs. + Tables. The Hague, April, 1918.

The paper under review contains an historical, geographical and economical survey of the Island of Sumatra, with a general historical introduction. It includes the hydrography, geology, climatology, ethnography, general economic development, agriculture, industry, and commerce of the district.

In the chapter on AGRICULTURE a special study is made of the cultivation of tobacco, one of the most important crops of the island. It was first started on a large scale and organised by Europeans towards the middle of the 19th. century. Several companies were formed, most of which cultivated rubber as well as tobacco. The development of tobacco was extraordinarily rapid in certain years; the total crop which, in 1864, was 460 cwt., rose in 1913 to 3 955 113 cwt. The first plantations were on cleared forest land. The produce was of a dark shade much in demand. To avoid continual clearing a rotation system was adopted including a tobacco crop every 6 or 8 years, followed immediately by a rice crop, after which the ground is left fallow for some time; as green manure *Crotalaria striata* is grown. The subsequent adoption of modern cultural methods produced a tobacco of lighter colour but fortunately without modifying appreciably the flavour or aroma. The tobacco is sown early in the year under frames ("pajongs") and when the plants have developed sufficiently they are transplanted. After a few months the plant is about 8 feet high and has 40 to 50 leaves, the longest of which are 19 ½ to 23 ½ inches long. The drying-rooms can hold an average of 1 million leaves, which are afterwards piled up so as to attain the necessary suppleness. In sorting preference is given to Chinese workers who are more apt than the natives to distinguish differences in the shade and consistency of the leaves. The sorted packets are compressed hydraulically into bales of 176 lb. The cultivation of tobacco has changed the appearance of the country, formerly covered with virgin forests, which have given place to plantations and dwelling. The swamps have been

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drained, roads and bridges built, sanitary conditions improved, and an agricultural experiment station ("Deli-Proefstation te Medan") established at Medan.

The more recent crops as yet cultivated to a smaller extent than tobacco are then described :—

1) RUBBER. — The cultivation of rubber on a large scale was started towards 1902, and has since developed rapidly. The plantations, which did not exceed 435 acres, in 1916 covered an area of 259 999 acres with a production of 15 265 metric tons. A yield of 45 000 metric tons is anticipated for 1921, and the district will then be able to supply an important percentage of the world production. Exportation was formerly chiefly to London, Antwerp, Amsterdam and Hamburg, but since the war it is more largely to America. In 1916 the exportation of *Hevea* rubber was :— United States, 112 936 cwt ; United Kingdom, 95 404 cwt. ; Singapore, 20 878 cwt. ; Penang, 11 219 cwt. ; Java, 117 105 cwt ; Netherlands, 435 cwt. The soil, usually white clay in the plains and darker on the hills, and the even, rainy climate without long periods of drought, favour the cultivation of *Hevea*, which supplies most of the rubber.

2) COFFEE. — In 1903 the average production was 42 600 *picol* (41 761 cwt.). Most varieties of coffee-plants only begin to yield 3 years after planting ; they are grown between the trees in the rubber plantations, which usually only begin to yield after 4 or 5 years. The varieties mostly grown are *Robusta* and *Liberian*, as well as *Javan*, and *Quillou* from the French Congo. In 1916 the exports amounted to 73 600 cwt.

3) TEA. — The district is fairly well adapted to tea-growing, which requires a moist atmosphere and continuous and regular rains. The exports, mostly to London, were 30 096 cwt. in 1916.

4) COCONUT. — This is grown particularly in the valleys and low districts along the coast as the sea assures the necessary humidity and constant temperature. In 1916, 90 348 cwt. of copra were exported.

5) OTHER CROPS. — In 1916 *oil-palms* were grown over 9 000 acres and this acreage will certainly be extended in view of the increasing demand for palm oil for making candles, vegetable butter, soap and glycerine. As there is a crop only every 3rd or 4th year coffee is also grown here between the trees. The *sago-tree* is partly cultivated, partly wild ; the exportation of sago amounted to 2 621 cwt. The *gambier* gives a resinous gum used for tanning and dyeing, of which 44 361 cwt. were exported in 1916, chiefly to Great Britain. *Betel* is obtained from the fruit of *Areca Catechu* L. The cultivation of *pepper*, once very flourishing, has greatly decreased. New crops have recently been attempted, particularly *agave*, *sesame* and *sugar-cane*. *Soya* has been introduced in the tobacco rotations.

6) FOREST TREES. — Before the arrival of Europeans most of the district was covered with forests, and wood was one of the most important branches of native trade. The exportation of forest produce has much decreased but is still fairly important. The extension of modern agricultural enterprise has spared only those forests on ground inaccessible for cultivation. For this reason the forests are found now especially on the mountains or hills. The principal trees are :—

*Ajzelia palembanica*, which gives an excellent wood for building; *Sloetia Sideroxylon* which yields a reddish wood which turns brown when exposed to the air; it is the most solid in the district. There is no very marked limit between the species of the plains and those of the hills, but there is transition, the larger specimens being found in the mountains. In the plains it is only in the relatively wild districts, interspersed with marshes, that forests are still found. Most of the species belong to the Dipterocarpaceae family; two Oleaceae — *Scorodocarpus borneensis* and *Ochanostachys amentacea* — give a good quality wood; one Loganiaceae — *Fagraea fragrans* — gives an almost white wood. *Ceriops Candolleana*, *Rhizophora conjugata*, *Bruguiera gymnorhiza*, etc., should also be mentioned.

The felling of wood is particularly along the water-courses and tends to increase more and more. The local consumption of building wood increases continually near the agricultural estates, and the authorities have taken steps to form reserve forests in the mountains.

833 — **The Influence of Specific Carbohydrates and Grains, Other than Oats, on the Development of Scurvy.** — PITZ, W. (University of Wisconsin, Madison), in *The Journal of Biological Chemistry*, Vol. XXXIII, No. 3, pp. 471-482 + 12 Charts; Bibliography. Baltimore, 1918.

I) *Effects of Carbohydrates and specially of Lactose.* — In a previous paper (1) McCOLLUM and PITZ had put forth the theory that scurvy in the guinea-pig results from the absorption of toxic substances arising from putrefaction in the cæcum due to undue retention of fæces.

HULL and RERRGER showed with white rats and also with men fed on a high protein diet that the bacterial flora of the intestine could be changed from a putrefactive flora to an acidophilus flora by the ingestion of lactose in the diet. Other carbohydrates as sucrose, dextrose, maltose, etc., produced a similar, but less pronounced, effect. It results from this that any substance that will thus change the intestinal flora should prevent the onset of the symptoms of scurvy. In order to test this supposition guinea-pigs were fed oat meal and whole milk, plus a carbohydrate. The results obtained show that a subject already affected begins to recover, while healthy subjects are completely protected by adding lactose to their diet. Excepting dextrose, which has only a slight action, the other carbohydrates had also a partially preventive action which, although less than that of lactose, maintains the animals in much better condition than when they are fed on oat flour and milk alone.

II) *Influence of Grains, other than Oats.* — The author fed guinea-pigs on ground grains of barley, wheat and maize, together with as much milk as they would consume (which favoured constipation). The barley grains caused scurvy after 4 weeks, those of maize after 5 to 6 weeks and those of wheat after only 3 weeks.

It may be concluded that grains of barley, wheat, and maize fed with large quantities of milk, so as to produce constipation caused scurvy.

(1) See *R.*, 1918, No. 517. (Ed.)

but did not favour it as much as oats. In fact, for these grains, 10 per cent of lactose added to them was just as effective in preventing scurvy as was 20 per cent when fed with oats.

834 - **An Experimental Chronic Beriberic Syndrome**(1). — WEILL, E. and MOURICAND, G., in the *Comptes Rendus des Séances de la Société de Biologie*, Vol. LXXXI, No. 8, pp. 432-435. Paris, April 27, 1918.

As the result of experiments made on pigeons, the authors have concluded that by the side of an acute beriberic syndrome (EYKMAN'S syndrome appearing about the 20th or 25th day) there exists a chronic beriberic syndrome that appears much later and which can be caused especially by a partially deficient diet (in the present experiments by a mixture of  $\frac{1}{3}$  of wholly raw seeds with  $\frac{2}{3}$  of sterilised seeds). This syndrome is characterised by incipient paralysis of the wings, which may be followed by paralysis of the claws; it is completely resistant to treatment with raw epidermis, considered to be a specific.

In the experimental, acute, beriberic syndrome, recovery is obtained in a few hours by administering raw epidermis or by injecting vitamins, as if the paralysis was solely due to a chemical change in the nerve centres. The chronic cases that are almost entirely resistant to treatment with epidermis appear to be caused by profound nervous lesions (a natural consequence of the chemical change). The clinically "functional" paralysis of the former cases should be clinically "lesional" in the latter.

In a note on the previous communication, M. L. LAPICQUE records similar results that he has obtained with mice fed exclusively on white wheat flour. After a few days the young mice showed serious disorders, which were at once cured with whole wheat. When fed with white flour the adult mice only showed the characteristic neuritis after several weeks, and when once the disorder was manifest, recovery could not be obtained by adding either casein or whole wheat to their diet.

835 - **The Value of the Yeast Vitamine Fraction as a Supplement to a Rice Diet.** — ENDMITT, A. D. and MCKIM, L. H., in *The Journal of Biological Chemistry*, Vol. XXXII, No. 3, pp. 409-419 + 4 Diagrams + Bibliography of 9 Publications. Baltimore, Md., December, 1917.

In the present paper the authors report the first of a series of investigations that deals more particularly with the efficiency of the vitamins from autolysed brewer's yeast (2), in respect to their value as an *adjuvant* to a diet that has been shown to be deficient in some particular vitamin.

From these studies, which have extended over a much longer period of time than any of those previously reported on this subject, it appears: —

1) That ordinary fuller's earth, ground to a definite fineness, absorbs the yeast vitamine fraction from the autolysed yeast filtrate as readily as the special form of fuller's earth, called Lloyd's reagent. Further, the

(1) See *R.*, 1916, No. 415; *R.*, 1917, Nos. 263 and 566. (Ed.). — (2) See also *R.*, March 1918, n. 344. (Ed.) See also: *B.*, 1912, No. 1130; 1914, No. 871; 1915, No. 1239; 1916, No. 612 and 1254. (Ed.)

"Kieselguhrs" (infusorial earth, "celite B," and "filtercel") do not absorb the yeast vitamine.

2) That these two forms of activated fuller's earth are equally potent and very efficient as therapeutic agents in the treatment for typical attacks of avian polyneuritis.

3) That silicates in the form of ordinary fuller's earth, Lloyd's reagent or infusorial earth, when added to a polished rice diet, do not inhibit or accelerate the onset of avian polyneuritis; and that lactose, used in making the vitamine tablets, is also inert in this respect.

4) That the activated fuller's earth when given as a rational supplement to a polished or a brown rice diet, acts as a partial stimulant to increase the weight of the treated polyneuritic pigeons; it does not, however, in the case of the polished rice, accelerate the increase in weight to anything like that which is produced under similar conditions with brown rice alone, corn, barley, or hulled oats; and comparatively speaking, this activated yeast vitamine is not a complete supplement to a polished rice diet.

5) That there are apparently two so-called vitamines associated with rice polishing, one which cures polyneuritis and one which produces weight, and of these two the SEIDELL yeast vitamine preparation contains chiefly the curative fraction, along with a small per cent of the other.

Finally, it is evident, that while this activated yeast vitamine product is a valuable adjuvant to the diet in the case of convalescents from avian polyneuritis, yet for the best results, the diet should, in addition, be made up in part at least of vitamine-containing foods, not for the purpose of preventing the recurrence of typical attacks of this dietary deficiency disease (for the preparation is able to do this) but with the object of bringing about normal gains in weight and complete recovery.

836 - Studies on the Digestibility of Some Nut Oils. — HOLMES, A. D. (Office of Home Economics), in the *U. S. Department of Agriculture, Bulletin* No. 630, pp. 19 + 7 Tables + Bibliography of 20 Publications. Washington, April 16, 1918.

The author undertook a series of studies on the oils of several nuts in order to determine their digestibility as compared with those of animal or vegetable fats commonly used as foods.

All the oils were administered in the same way and with the same rations, so that the results as to their digestibility were directly comparable. A blancmange, or cornstarch pudding, was used as the basis of the ration and contained the oil for experiment; wheat biscuit, oranges and sugar were also given. All the food was cold with the exception of tea or coffee (without milk) which the subjects were allowed to take with their meals if they liked. The subjects were adult men between 20 and 40 years of age, mostly engaged in mental work, but taking sufficient exercise to make their energy requirement greater than that of most people with sedentary professions.

The experiment lasted 3 days and included 9 meals. The faeces were carefully analysed. The oils tested, the average daily amount consumed, and their coefficient of digestibility were:

- 1) Almond oil from *Prunus Amygdalus*, ration 70 gm., coefficient of digestibility 97.1 %.
- 2) Black-walnut oil, *Juglans nigra*, ration 56 gm., coefficient of digestibility 97.5 %.
- 3) Brazil-nut oil, *Bertholletia excelsa*, ration 81 gm., coefficient of digestibility 96.3 %.
- 4) Butternut oil, *Juglans cinerea*, ration 43 gm., coefficient of digestibility 95.4 %.
- 5) English-walnut oil, *Juglans regia*, ration 78 gm., coefficient of digestibility 97.6 %.
- 6) Hickory-nut oil, *Carya ovata*, ration 95 gm., coefficient of digestibility 99.3 %.
- 7) Pecan oil, *Carya Pecan*, ration 104 gm., coefficient of digestibility 96.8 %.

The average daily amounts given above are not maximum and may be exceeded.

These oils have about the same digestible qualities as the common vegetable oils (cottonseed, groundnut, olive oils, etc.). They are all liquid at ordinary temperatures. The data obtained with regard to the digestibility of the protein and carbohydrates consumed with these oils show them to have no abnormal influence on the digestibility of other foods eaten with them. The results show that, as these oils are very well assimilated by the human body, they may be used freely for food purposes.

**37 - Experiments on the Digestibility of Fish.** — HOLMES, A. D. (Specialist in Charge of Digestion Experiments, Office of Home Economics), in *U. S. Department of Agriculture, Bulletin No. 649*, 24 pp. Washington, April 13, 1918.

In the study of the digestibility of the protein and fat supplied by some common varieties of fish, fish in the form of "fish loaf" was served as the major part of a simple mixed diet, which also included potatoes, crackers, fruit, sugar, and tea or coffee. Considering the experiments as a whole, the total diet supplied on an average 99 gm. of protein, 60 gm. of fat, and 160 gm. of carbohydrates daily, the fuel value being 1576 calories. The low amount of fat and of carbohydrates was due to the fact that butter and similar fats were omitted and the foods other than fish loaf which supplied both protein and carbohydrates, were limited in order that both the fat and the protein in the diet might be contributed in as large proportion as possible by the fish.

The principal results are summarised in the following table : —

Number of experiments	Kind of fish	Average amount of fish eaten per man per day grams	Digestibility of fish protein	Digestibility of fish fat
			per cent	per cent
3	Mackerel ( <i>Scomber scombrus</i> ) . . . . .	448	93.1	95.2
3	Butterfish ( <i>Peromatus triacanthus</i> ) . . . . .	471	91.9	86.4
8	Grayfish ( <i>Squalus acanthias</i> ) . . . . .	440	92.8	94.3
4	Salmon ( <i>Oncorhynchus tshawytscha</i> ) . . . . .	355	93.2	93.7



As these figures show, the average coefficients of digestibility for fish proteins are in close agreement, therefore it would seem, from a dietetic standpoint, that the different fishes studied would supply protein in equally available form. The fats were well assimilated in the case of the mackerel, grayfish, and salmon, which, according to the usual custom, are to be regarded as "fat fishes". Considering the experiments as a whole, the very complete utilisation of the protein and fat supplied by the fishes studied offer additional experimental evidence that fish is a very valuable food and that its extensive use in the dietary is especially desirable.

### CROPS AND CULTIVATION.

838 - **Movement and Distribution of Moisture in the Soil** (1). — HARRIS, F. S. and TURPIN, H. W. (Utah Agricultural Experiment Station), in *Journal of Agricultural Research*, Vol. X, No. 3, pp. 113-155, 31 Figs., Bibliography of 35 Publications. Washington, D. C., July 16, 1917.

During recent years considerable difference of opinion has arisen regarding the importance of the capillary movements of soil moisture and also regarding the laws governing the final distribution of moisture in the soil. In order to solve this problem the authors carried out a series of laboratory and field experiments under irrigation and dry-farming conditions. The experiments represent several thousand moisture determinations. The field studies include the effect of fallow, kind of crop, manure, irrigation water, surface mulches, cultural methods, and seasonal conditions on the movement and distribution of soil moisture. The laboratory studies include the effect of the initial percentage of moisture, gravity, soil-type, source of supply, etc., on the movement and distribution of moisture in the soil.

**RESULTS.** — In field soils the moisture content of the fallow soils averaged greater than that of the cropped soils.

Unmanured irrigated land showed less difference in moisture between cropped and fallow than did the manured.

Irrigation influenced the top feet of the cropped plots proportionately more than the fallow, but water did not appear to penetrate the fallow plots below 7 feet as readily as it did the cropped ones. Under dry farming conditions the difference in moisture between cropped and fallow plots was not noticeable until after June 16. Cropped plots showed more fluctuation than fallow ones. Wheat, maize, potatoes, and peas drew most of their moisture from the first 4 feet in depth. The wheat land contained less moisture in the autumn than the other cropped soils, with maize following.

The increase in moisture due to applications of 5 to 7½ inches of irrigation water was felt to depths of 10 feet in 24 hours, although most of the increase was in the first 4 feet.

(1) See also *B.* April 1914, No. 368; *R.* January 1916, No. 8; *R.* Dec. 1917, No. 1114; *R.*, February 1918, No. 128. (Ed.)

The effect of mulches in preventing moisture loss under both irrigation and dry-farming was noticeable several feet below the surface of the ground, but the surface foot showed the greatest benefit from mulches. A straw mulch proved considerably better than a 2-inch soil mulch.

Mulches on irrigated plots appear to influence the moisture content of the soil to greater depths than do those under dry-land conditions. A dry-farm plot kept free from weeds in 1916 but not mulched lost very little more water than one mulched 2 inches deep. A 6-inch cultivation on spring-ploughed and a 2-inch cultivation on autumn-ploughed dry-farm land seemed to conserve the moisture best.

Subsoiling 15 inches deep had little influence on the moisture; spring discing was rather a distinct benefit.

An 8-year average shows that spring ploughing under dry-farming conditions at Nephi conserves moisture better than autumn ploughing. This difference in favour of spring ploughing is shown more below the first foot than in the first foot, and more in summer and autumn than in spring.

A precipitation as small as 0.1 inch under dry-farming conditions could not be detected in moisture determinations soon after, but, when as much as 0.5 inch fell within a short time, an increase in moisture was noticed to a depth of 6 feet.

When freely supplied with water, a soil with a high initial percentage of moisture will come to a moisture equilibrium sooner than a drier one, but if given time the drier soil will absorb a greater quantity through a long distance either upward or downward than will the wet one.

The rate of moisture penetration in the first 10 days was nearly twice as great with initial percentages above 15 as with 5 or below, and nearly twice as rapid after a 15-inch irrigation as after a 5-inch one. Under the most favourable conditions 7 feet was influenced in 10 days.

Moisture movement from soils of optimum moisture content into soils of differing initial percentages varied to an extent inversely as the initial content of the dry soil. At the end of six weeks, however, the amount of water actually in the soils still varied directly as the initial percentage.

The higher the percentage of moisture in the soil supplying the water to a dry-soil, the more rapidly and farther from the source of water did the moisture move.

Even when the source of water was an unsaturated soil, greater and faster movement took place when the water was moving downward than upward. When the quantity of soil yielding the water was so small as to make the total moisture content of both moist and dry soils very low if equally distributed, the effect of gravity was not great.

Moisture from a nearly saturated soil moved a greater distance into loam than into sand in 139 days and into sand farther than into clay. The clay, however, contained more moisture in the layer of soil next the water supply than the others and sand contained by far the least.

Sand, with 7.77 per cent of moisture, gave up its moisture to loam much more readily than did loam with 31.09 or clay with 24.62 per cent of moisture.

The rate of rise of moisture from soils of varying fineness when used either as water sources or water absorbers varied inversely with the fineness. Water rose to a height of over 30 inches in a loam soil from a moist sand in 94 days, while from a moist clay it rose little more than 6 inches in this length of time. In all soils the most rapid rise of the water was during the period soon after being placed in contact with the water.

Although the rise of the moisture was more rapid in the sand and loam than in the clay, the rise continued steady longer in the clay than in the others.

**839—Studies in Soil Reaction as Indicated by the Hydrogen Electrode** (1).—I. PLUMMER<sup>1</sup> J. K. (North Carolina Agricultural Experiment Station), *Studies in Soil Reaction as indicated by the Hydrogen Electrode*, in the *Journal of Agricultural Research*, Vol. XII, No. 1, pp. 19-31, + 8 Tables + Bibliography of 13 Publications. Washington, D. C., January 7, 1918. — II. HOAGLAND, D. R. and SHARP, L. T. (Agricultural Experiment Station of the University of California), *Relation of Carbon Dioxide to Soil Reaction as Measured by the Hydrogen Electrode*, in the *Journal of Agricultural Research*, Vol. XII, No. 3, pp. 139-148 + Bibliography of 11 Publications. Washington, D. C., January 21, 1918.

The hydrogen electrode has been used by the author for indicating soil reaction on a number of untreated soils in suspension. The soils experimented with represent a wide range in texture of those common to the area of the southeastern portion of the United States, extending from and including the Appalachian Mountains to the Atlantic Ocean. The H-ion concentration varies from almost "true neutrality" to rather excessive "true acidity" in the soils.

With the Morgan apparatus for extracting film water from soils, it was shown that its reaction is the same as the free water, differing only in intensity.

The effects of certain fertilisers on the H-ion concentration of long-time-treated plots of three soils were measured, with the following results: — 1) ammonium sulphate materially increased the H-ion concentration of all plots which received applications of this material. The acidity thus developed often extends to the subsoil; 2) sodium nitrate slightly reduced the acidity of the plots to which it was applied; 3) potassium sulphate increases the "true acidity" when applied to soils, though not as greatly as ammonium sulphate; 4) acid phosphate does not appear to affect in either direction the H-ion concentration of field soils. 5) Lime materially increases the OH-ion concentration of field plots to which it has been added.

The acidity developed from ammonium sulphate was more intense in the film than in the free water of the three soils.

Monocalcium phosphate does not change in any way the soil-film water until excessive amounts are added.

(1) Though the hydrogen electrode has been used for some time in indicating changes in reaction, GILLESPIE was the first to use it on an extended scale as an indicator of reaction in soils (See R. 1916, No. 733). Later SHARP & HOAGLAND measured the hydrogen-ion concentration of numerous soils in suspension and they also applied the method to the study of other phenomena of the soil.

II. — In a previous article (SHARP, L. T. and HOAGLAND, D. R., *Acidity and Absorption in Soils as Measured by the Hydrogen Electrode*, *Journal of Agricultural Research*, Vol. VII, No. 3, pp. 123-145) the authors have presented data concerning the question of soil reaction as determined by the hydrogen electrode. Since this work did not include direct measurements of the effect of carbon dioxide on the reaction of soils, it was thought desirable to carry out further experiments on this point.

The H-ion concentrations of soil suspensions were measured under various partial pressures of carbon dioxide, with the following results: —

The H ion concentration of suspensions of acid soils is not markedly affected by increasing the content of carbon dioxide up to 10 per cent. The H-ion concentration of slightly alkaline soils is slightly increased by such treatment. A notable increase in H-ion concentration is observed when soils containing alkali carbonates are similarly treated.

It has not been found that any treatment with carbon dioxide can produce an alkaline reaction in the suspension of an acid soil.

When the original conditions are restored, no permanent change in soil reaction could be attributed to the carbon dioxide.

Further experiments with the hydrogen electrode have confirmed the point of view that solutions in equilibrium with acid soils contain H-ion in excess of OH-ion.

840 — **Humus in Mulched Basins, Relation of Humus Content to Orange Production, and Effect of Mulches on Orange Production.** — JENSEN, C. A. (Bureau of Plant Industry, U. S. Dept. of Agric.), in *Journal of Agricultural Research*, Vol. XII, No. 8, pp. 505-518, 8 Tables, Bibliography of 10 Publications, Washington, D. C., February 25, 1918.

This report presents a study on: — a) the changes in humus content in soils in basins mulched with different organic substances; b) the effect of lime on humus content in soils in mulched basins; c) the relation of humus content in the soil to orange production.

By "humus" is meant the brown- to black-coloured organic extract obtained from soil leached with 1 per cent hydrochloric acid to remove the calcium completely and the soil residue boiled for two minutes in a 7.5 per cent sodium hydrate solution.

Humus determinations in mulched basins in citrus groves showed a fluctuation in the percentages of humus from time to time. The average percentage of humus increased more in basins on clay loam soil than in basins on lighter soils, with manure and alfalfa as mulching materials. Usually the percentage of humus in basins increased more when manure was used as mulch than when alfalfa was used as mulch. This seemed, however, to be due more to the humus added with the manure than to the greater "humification" of the manure over the alfalfa. When manure alone was used as mulch in basins the increase in humus was greater than when lime was added with the manure. In most cases when lime was added to alfalfa in basins greater increase in the humus content occurred than when alfalfa alone was used. Blood, acid phosphate, bone meal, tankage, or sulphur did not show any appreciable influence on the changes of humus content in mulched basins. It was not evident that there was any appreciable accu-

mulation of humus in the lower depths of soil due to the leaching of humus from the surface foot of soil. There was no evident correlation between the amount of humus in the soil in mulched basins and the amount of fruit on the trees. There was no evident effect of lime on orange production in these experiments. Alfalfa and bean-straw mulch in basins on the heavier soil types produced from 30 to 100 per cent more oranges per tree than manure mulch. Manure mulch produced more oranges per tree than either barley hay, sweet clover, bur clover, or pine shavings. These differences were obtained in the summer following the application of the mulches in the preceding autumn. Alfalfa mulch and manure mulch in basins on the lighter types of soil produced no observable differences on fruit production of lemons in the course of one year. In all experiments so far conducted by the Office of Biophysical Investigations, Bureau of Plant Industry, in the Riverside area, the mulched-basin system on the heavier soil types has produced favourable growth response in a few months. It usually takes longer to produce appreciable response on the lighter soil types. It appears that the degradation products from freshly decomposing organic substances are more effective in orange production than the amount of "humus" formed. And the value of a given mulch does not necessarily depend upon its being a legume or non-legume.

841 - **Formation of Black Alkali (Sodium Carbonate) in Calcareous Soils.** — BREAZEALE, J. F. (Biophysical Investigations, Bureau of Plant Industry, U. S. Dept. of Agric.), in *Journal of Agricultural Research*, Vol. X, No. 11, pp. 541-589, 26 Figs., 48 Tables + 1 Plate, Bibliography of 7 Publications. Washington, D. C., September 10, 1917.

With the exception of an adequate water supply, the presence and accumulation of alkali is probably the most important problem that confronts the man engaged in farming under irrigation in the arid and semi-arid regions of the West.

As ordinarily used, the term "alkali" indicates the salts of sodium, together with calcium and magnesium salts in lesser amounts. In this paper the term includes all the water-soluble salts of the soil, whether organic, or inorganic. This paper discusses only one specific phase of alkali formation and that is that which takes place when sodium salts are present in a calcareous soil. The conclusions arrived at are as follows: —

1) In the reaction between sodium nitrate (or sodium chloride or sodium sulphate) and calcium carbonate, resulting in the formation of sodium carbonate, the presence of relatively small amounts of calcium nitrate or calcium chloride in the reaction impedes and may prevent the formation of sodium carbonate.

2) The presence of a saturated solution of calcium sulphate in this reaction does not entirely stop the formation of sodium carbonate.

3) Sodium nitrate, sodium chloride and sodium sulphate in the presence of carbon dioxide react with calcium carbonate with the formation of sodium bicarbonate.

4) The presence of relatively small amounts of calcium nitrate or calcium chloride in this reaction impedes and finally prevents the formation of sodium bicarbonate.

5) The presence of calcium sulphate has no effect in preventing the formation of sodium bicarbonate when sodium sulphate or a mixture containing sodium sulphate reacts with calcium carbonate.

6) A field application of gypsum will probably have no effect in overcoming black alkali if the soil already contains soluble sulphates in appreciable amounts, or if the irrigation water contains these salts.

7) Sodium nitrate, sodium chloride, and sodium sulphate increase the solubility of calcium carbonate in the soil.

8) Sodium nitrate, sodium chloride, and sodium sulphate react with calcium carbonate in the soil with the formation of sodium carbonate ("black alkali").

9) Sodium carbonate, formed by the above reaction, decomposes the organic matter of the soil.

10) Calcium carbonate has a slightly destructive action upon the organic matter of the soil.

11) Sodium carbonate is much more destructive to organic matter than sodium bicarbonate.

12) The alkali crusts that accumulate upon the soil in some irrigated regions are due in part to the action of sodium salts upon calcium carbonate with the formation of sodium carbonate.

13) Barren, or "slick", spots are often due to the action of sodium nitrate, sodium chloride, or sodium sulphate upon calcium carbonate with the formation of sodium carbonate.

14) Sodium chloride and sodium sulphate have a protective action upon organic matter in the presence of sodium carbonate.

15) A calcareous hardpan often produces black alkali.

842 - **Influence of Carbonates of Magnesium and Calcium on Bacteria of Certain Wisconsin Soils.** — FULMER, H. L. (Wisconsin Agricultural Experiment Station), in *Journal of Agricultural Research*, Vol. XII, No. 8, pp. 463-504, 19 Tables, 11 Figs., Bibliography of 64 Publications, Washington, February 25, 1918.

It is a well-established fact that the majority of the changes of soil constituents are brought about by microorganisms and are influenced by the number and kinds of bacteria. The beneficial effect of lime, calcium carbonate, and magnesium carbonate on the growth of higher plants is generally preceded by an increase in the number of bacteria. An increase in the number of soil microorganisms is usually reflected in a more rapid decomposition of organic matter and a greater liberation of the inorganic soil constituents, chiefly potassium and phosphorus.

Although many important data have been obtained in relation to the effect of liming on the bacteria in soil, there still remain problems which deserve careful investigation — for example, the amount and kind of lime and calcium and magnesium carbonates that can be applied most economically and yet give the best results. The investigations described were undertaken with the hope of throwing some light upon the problem of soil bacteria and their response to applications of magnesium carbonate, calcium carbonate and limestone. The effect of these substance on pure cul-

tures of bacteria and on the ordinary soil flora was observed in: — *a*) acid Colby silt loam soil; *b*) acid Plainfield sand; *c*) neutral Miami silt loam.

From a brief review of certain of the more important papers relating to the effect of lime (CaO), calcium carbonate and magnesium carbonate on soil microorganisms it appears that the addition of calcium and magnesium, either in the form of oxide or carbonate, to soil, and especially to acid soil, brings about conditions favourable to the growth of certain groups of microorganisms. There are many factors which have been given little or no consideration — for instance, what relationship exists between the total number of bacteria in soil and the quantity of soil acid neutralized? With few exceptions, little attention has been directed toward the relative effect of calcium and magnesium carbonates on the soil flora. There exists a diversity of opinion with regard to the relation of bacteria to these two compounds. This lack of harmony may be due to the difference in the soil types which have been studied. Again, it seems that no one has tried to measure the effect of calcium and magnesium carbonates on pure cultures of bacteria in sterilized acid soil. To obtain information with regard to these points, a series of experiments was planned.

Each of the 3 experimental soils was passed through a 4 mm. sieve and mixed. The calcium carbonate requirement of the 2 acid soils was determined: — to correct the active acidity of 100 gm. of soil on the dry basis 1.05 gm. were required for the Colby silt loam and 0.21 gm. for the Plainfield sand. Three bases were used to neutralize the acidity in these soils: — 1) pure precipitated calcium carbonate; 2) pure precipitated magnesium carbonate; 3) commercial ground limestone with 53 per cent of calcium and 43 per cent of magnesium oxide. They were added in amounts sufficient to neutralize  $\frac{1}{4}$ ,  $\frac{1}{2}$  and the total active acidity. In certain experiments varying amounts of monocalcium phosphate were added to the soil, alone and in various mixtures with calcium carbonate. The mixtures of soil and bases were poured into earthenware jars and the moisture content raised to one-half saturation with distilled water. At definite intervals samples were drawn and plate counts made. At regular intervals the effect of these compounds on the total number of bacteria in the soil, on ammonification and on nitrification was studied. The results were as follows: —

The number of bacteria in acid Colby silt loam and acid Plainfield sand is increased by the application of calcium carbonate, magnesium carbonate, or limestone. Magnesium carbonate increases the number to a much greater extent than does either calcium carbonate or limestone. Monocalcium phosphate and dibasic magnesium phosphate slightly increase the total number of bacteria in neutral soil.

Nitrification is benefited by limestone, calcium carbonate, and magnesium carbonate treatment. Magnesium carbonate in soil to which no nitrogenous substance was added favours nitrate accumulation more than does either calcium carbonate or limestone. The phosphates increase the accumulation of nitrate nitrogen to a very small extent. When gelatin was applied to the soil, magnesium carbonate did not benefit nitrification any more than calcium carbonate or limestone.

Ammonification in Colby soil is benefited by all three forms of the carbonates, while in Plainfield sand a decrease in ammonia is shown. Monocalcium phosphate increases ammonification in both soils.

Pure cultures of *Bacillus tumescens* and *B. subtilis* ammonify blood meal better when sterile Colby soil is treated with any one of the three forms of carbonates. A culture of *B. azotobacter* in the two soils treated with the carbonates and mannite fails to show an increase in total nitrogen in the sand and only a slight gain in the Colby soil. Pure cultures of *B. radicola* of both alfalfa and lupine strains, and *B. azotobacter* are greatly benefited when inoculated into sterile Colby soil previously treated with magnesium or calcium carbonate. Limestone barely increases the number of *B. azotobacter* in Colby soil. In neutral and acid soils treated with magnesium carbonate until they were strongly alkaline, *B. azotobacter* greatly increases in number in comparison with that of the untreated.

From the data considered as a whole, magnesium carbonate is superior to calcium carbonate or limestone in stimulating the reproduction of bacteria in Colby silt loam and Plainfield soils. In general, the smaller applications of either compound give better results than do the heavier applications. Magnesium carbonate appears to play an important part in the development of soil bacteria, much more so than does calcium carbonate. Magnesium phosphate, when applied to neutral soil, caused an increase in the number of bacteria. In the neutral soil magnesium phosphate proved superior to calcium phosphate in stimulating the bacteria; in acid soil neither compound appeared to benefit the soil flora.

843 - The Gases of Swamp Rice Soils. — Part III. A Hydrogen-Oxidising Bacterium from these Soils. — Part IV. The Source of the Gaseous Soil Nitrogen. — HARRISON, W. H. and SUBRAMANIA AIVAR, P. A., in *Memoirs of the Department of Agriculture in India*, Chemical Series, Vol. IV, No. 4, pp. 135-148, 1 Fig., 9 Tables; Vol. V, No. 1, pp. 1-31, Figs. and Diagrams. Calcutta, 1916.

In a preceding memoir (1) published by the authors dealing with the relationship between the gases of swamp rice soils and the organized film present on the surface of the soil, it was shown that the latter possessed the power of oxidising hydrogen. This oxidation was further demonstrated to be due to the activities of certain bacteria and crude cultures were obtained and their action studied. A pure culture of a specific bacterium has been obtained and it is with this organism that the third part deals. It contains a description of the hydrogen-oxidising organism, together with the effect of different concentrations of various nitrogen containing chemicals upon its power to oxidise hydrogen. No name is assigned to the organism, but it is said to be different from previously described hydrogen-oxidising bacteria.

Part IV deals with explanations for the variation in quantity and composition of gases evolved from cropped and uncropped soils during different stages of growth. The authors demonstrate that a very considerable proportion of the gaseous nitrogen normally found in swamp paddy

(1) See R., 1914, No. 119; 1915, No. 490. (Ed.).



soils is produced through the decomposition of organic matter. The nitrogen thus liberated is derived from two distinct sources: a) from the decomposable organic matter of the soil or of the green manure used, and b) from a certain proportion of the roots of the crop which die and subsequently decompose. The production of gaseous nitrogen from soil organic matter and green manure persists throughout the growing season, but is most prominent during the earlier period, whereas that derived from root decomposition is most prominent during the later stages of growth and persists after harvest time. The crop does not interfere with, or materially alter, the normal course of the fermentation of the soil organic matter and green manure. The difference in the rate of evolution of gases from cropped and uncropped soil is due to a matted root condition existing near the surface which in conjunction with the fine soil particles mechanically hinders the escape of gases on cropped soil. After appreciable quantities of gas accumulated and the roots began to decay, which occurred about the time rice was jointing, the accumulated gas began to escape in large quantities, whereas on uncropped soil the escape was very uniform throughout the growing period. The difference in composition was found to be due to the influence of the same factors. The methane and hydrogen retained near the organised surface film was oxidised thus giving to the gas finally escaping from cropped soil a much higher per cent of nitrogen and lower per cent of methane and hydrogen.

844 — **Artificial Glaciers for the Irrigation of Mountain Pastures, in India.** — I. DAINELLI, G., in the *Rivista del Club Alpino Italiano*, Vol. XXXVII, Nos 1, 2, 3, p. 30. Turin, January, February, March, 1918. — II. LUIGGI, L., in the *Annali d'Ingegneria e d'Architettura*, Year XXXIII, No. 9, pp. 139-140, Rome, May 1, 1918.

I. — Sig. G. DAINELLI, who explored the Caracoram hills in 1913-1917, records that the inhabitants of Cunis built an artificial glacier so that they could extend their fields and have sufficient water to irrigate them. The method was to choose a spot as high and elevated as possible and well protected from the sun; on a bed of straw they next placed a layer of gourds filled with water following with alternate layers of gourds and straw. If possible the straw is mixed with briars and wood charcoal. At the beginning of winter stones are laid on the upper layer, then a number of wide-necked earthenware pots full of water, which naturally freezes. After 2 or 3 months, when the great winter falls of snow have ended, the snow is covered, first with straw, then with earth, thus covering all the preceding material. The inhabitants repeat the same procedure the second and third years, extending the area each time. If, for example, 200 gourds are placed the first year, the second year 400 are placed, and so on. At the end of the fourth year the glacier is ready, and grows spontaneously each year, while each summer it furnishes the water required for the fields. The author has heard of artificial glaciers that have been working for over 40 years. The preservation of the initial glacier, i. e., that produced artificially by the 4 year's work, is easily explained as the materials that protect the successive masses of winter snow both above and below are bad conductors of heat. It is more difficult to explain how the glacier continues to work

afterwards without the addition of fresh insulating material. Very probably the fresh snow fallen on the system, while free from the warming action of the soil, melts in the summer on account of the air temperature, but freezes again on coming in contact with the underlying artificial layers at a very low temperature; the snow thus feeds the lower layers and compensates for the losses due to melting in summer. It is these losses that are used for irrigating the fields lying at a lower level. The fact recorded by the author was briefly described in 1867 by Mr. JOHNSON (1) in the description of his exploration journey across the Himalayan mountains.

II. — Prof. LUIGI LUIGGI, pointing out the construction of these artificial glaciers, is of the opinion that their construction as artificial lakes in the mountains would help to make the water supply more regular, and would lead to a more complete and better utilisation of the natural supplies of water of Italy.

845 - **Leakages from Irrigation Canals and Reservoirs in the U. S. A.** — DAVIS, A (Director and Chief Engineer, U. S. Reclamation Service), in the *Engineering News-Record*, Vol. LXXX, No. 14, pp. 663-665. New-York, April 3, 1918.

In numerous cases in the United States the admission of water into irrigation canals and reservoirs has disclosed the existence of subterranean cavities not previously observed. The author quotes three examples of canal troubles (those of Flathead; Grand Valley Lands, Colorado; and Spanish Fork Canal, Utah) and six of difficulties with reservoirs (Jerome and Deer Flat reservoirs, Idaho; Lake McMillan and Hondo reservoir, New Mexico; Walnut Cañon reservoir, Arizona; and Tumalo reservoir, Oregon). For each of these he describes the difficulties and the remedies applied, discussing the successes or failures.

Some of the difficulties encountered, especially in canal building, are of such nature that no method of foreseeing them appears to be possible.

In the case of canals, however, these difficulties are usually easily remedied, either by puddling the cavities that appear, as at Flathead and Grand Valley, or by relocation, as at Calsbad. Remedies in the case of reservoirs are not so easy. Puddling is useless if the subterranean conditions are such that the seepage of water can get away and thus let the seepage continue. No reservoir in earth is of much value if it continuously seeps at the rate that water can pass vertically through puddled earth. The problem then is to avoid regions where subterranean conditions are such that the water can escape. A few rules of caution may be of value: —

- 1) Avoid reservoirs adjacent to gypsum deposits and to limestone deposits which show evidence of caves.
- 2) Examine critically reservoirs in volcanic rock, as a few have failed in such locations. Coarse-grained sandstone seems to be an object of suspicion and should be carefully examined.
- 3) Natural depressions are treacherous and should be examined with

(1) JOHNSON, W. H., Report on his journey to Ichi, the Capital of Khotan in Chinese Tartary, *Journal of the Royal Geographical Society*, 1867, Vol. 37, p. 23. (Author).

care, and if they are near deep cañons or underlain with coarse material where water might readily escape, no superficial tightness will avail to make them effective.

846 - **New Deposits of Guano in the Philippines.** — In the *Philippine Agricultural Review*, Vol. X, No. 3, p. 301. Manila, 1917.

Owing to the inability to secure fertilizer material by even those planters who have learned the value of fertilizer for the growing of sugar cane, extensive search has been made for deposits of bat guano in the various parts of the Philippine Archipelago. In several instances, particularly in the southern provinces of the Island of Luzon, these searches have resulted in the location of extensive guano deposits. This material, however, has invariably contained a low percentage of nitrogen which condition was due no doubt to the extremely soluble substance containing that element having leached away during the rainy seasons. Analysis of this material showed the following average result: — Nitrogen 1, phosphoric anhydride 15, and potash 1 per cent.

847 - **Fertilising Value of Ammonium Nitrate.** — SCHÖESING, TH. JR., in *Le Progrès Agricole et Viticole*, Year 35, No. 22, pp. 517-519. Montpellier, June, 1918.

Ammonium nitrate, hitherto little known by farmers because it has never been available in large quantities, will be able to be supplied liberally to them when no longer used for the purposes for which it is required under present circumstances. For this reason the author made tests of its fertilising value by pot experiments. Maize seeds of equal weight were sown in each pot, which contained about 17 lb. of soil with an initial moisture percentage of 12.0, and 15 gm. bipotassium phosphate as basic fertiliser. Except in the two control pots the nitrogenous fertiliser added to each contained 3.37 gm. of nitrogen; four pots contained ammonium sulphate and four ammonium nitrate. The plants were cut down to the ground at the beginning of earing and the following average weights per pot of the air-dried crop were obtained: — Control pots, 87.6 gm.; pots with ammonium sulphate, 106.8 gm.; pots with ammonium nitrate, 108.4 gm. Ammonium nitrate thus gave an increase in the dried crop almost equal to that of ammonium sulphate.

The soils in the pots was kept very moist. It was found that, although nitric nitrogen fertilisers give slightly heavier crops than ammoniacal nitrogen fertilisers, there is little difference in yield in very wet years.

It is usually admitted that the nitrogen of ammoniacal fertilisers must be nitrified before it can be used by plants. Several workers (MÜNTZ, MAZÉ, SCHÖESING JR.) have, however, shown that absorption occurs in the ammoniacal form as well as in the nitric one. The only difference is in the rate of absorption, a difference which might be explained by an influence of the absorbing properties of the soil on the ammonia. Till it is nitrified ammonia will also be less mobile. For this reason an excess of water, while favouring the equilibrium movements which cause the dissolution of new quantities retained in the soil in proportion as absorption progresses, exercises a very good influence in this case.

## 848 - The Potassium Problem (1) and the Utilisation of Olive Oil Residue, in Italy.—

L'ABATE, G., *Il problema della potassa e l'utilizzazione delle "morchie"*, pp. 8. Bari, Laterza & Figli, 1918.

The potassium question is one of the most serious problems for all agricultural countries, especially Italy, which consumes much less than other states using it, though they may be less agricultural. Among the various types of fertilisers, some of which, the superphosphates, have developed greatly, potassium is not yet very largely used by Italian farmers. As sources of potassium in Italy there are the mother-lyes of the salt-springs; the leucites of Latium, the ashes of wood and other vegetable products (almond shells, exhausted olive cake). Taking the whole as a sole source of potassium salts for agriculture, there only remains at present, according to the author, distillery residue, and, as a less limited and hitherto untested source, the residue ("morchie") from the manufacture of olive oil.

Samples of olive oil residue from the province of Bari showed the following composition, in grams per litre:— water, 884-891; mineral, 30.65-35.48; organic matter, 79.85-80.60; fat, 10.50; nitrogen, 10. These results led to a comparison between the residue from olive oil with that from distilleries and molasses, with a view to using it, like these products, for extracting potassium salt of the following composition:— water-soluble matter, 80.31 %; matter insoluble in water (carbon, silica, lime, magnesia and 8 % phosphoric acid combined with calcium, iron, and aluminium), 19.09 %; potassium carbonate, 55.15 %; sodium carbonate 2.57 %; potassium chloride, 21.89 %; traces of potassium sulphate; water, and other undetermined substances, 20.39 %. When refined this product gives on an average:— potassium carbonate, 68.88 %; sodium carbonate, 3.2 % and potassium chloride 27.27 %, thus resembling, in its potassium content, similar products extracted from molasses and used as fertilisers.

The olive oil residues of Apulia give more than 30 gm. of potassium salts per litre, equivalent to 3 kg. (6.6 lb.) per hectolitre (22 gals.), with 48 % of potassium as carbonate (50-60 %) and chloride (15-20 %). The yield of olive oil residue, although depending largely on the weather, represents almost three times the amount of oil produced, or 30 to 40 % of the weight of the olives. If the oil production of Italy is placed at 44 million gallons or 35 200 000 gallons as in the period 1909-1913, the amount of residue would be about 16 500 000 bushels. If all this were used, about 294 000 cwt. of crude potassium salt containing 141 320 cwt. of potassium would be obtained. If the nitrogen as well as the potassium is to be utilised it may be obtained as ammonium sulphate and potassium cyanide (e. g. by EFFRON'S method).

In conclusion, the treatment of the 16 500 000 bushels of olive oil residue produced by Italy for the extraction of potash in factories in the districts with the largest production resolves itself essentially into a problem of transport, as for all poor and bulky matter.

(1) See R. April, 1918, No. 304. (Ed.)

849 — **Plant Succession in the South African Thorn Veld.** — BEWS, J. W., in *The South African Journal of Science*, Vol. XIV, No. 4, pp. 153-172 + 10 Pigs. Cape Town, November, 1917.

The tree veld is perhaps the most extensive type of vegetation in the Continent of Africa. The species composing it in the various districts depend chiefly on climatic differences, but also on the soil. Practically all the dry valleys in the east of S. Africa are covered with tree veld in which species of acacia predominate. The Protea Veld is more mountainous and extends throughout Rhodesia. There are also other types of veld in this region, such as the Baobab (*Adansonia digitata*) Veld. The Transvaal Bush Veld is a combretaceous-leguminous type with *Terminalia*, *Combretum*, *Burkea*, etc. The mopane (*Copaifera mopane*) is predominant in a large part of the Tree Veld of Angola and South Central Africa, whereas the Baobab Veld extends up to the Congo. Nearly all South Central Africa is Tree Veld, broken only by forests on the mountain slopes in the east. In the tropics, the great Congo forest and the dense forests which extend throughout the Cameroons and West Africa to Liberia cover a very extensive area, but north of this, and south of the Sahara there is Tree Veld very similar to that of S. Africa. In many parts of the tropics and sub-tropics various palms, such as *Hyphaine ventricosa*, *H. thebaica* or dum palm, *Borassus flabellifer*, etc., predominate. In view of the extent and importance of this type of vegetation in Africa, the study of the natural succession of plants in the veld is of the utmost value.

The species of trees, bushes and lianes which cover the Thorn Veld establish themselves in ravines and on the banks of water courses where the first seeds are carried by birds and other animals. These areas serve as bases for re-stocking the intermediate spaces. The author illustrates this vegetation by that observed at Bisley, where the most common trees, in order of their abundance, are: —

*Acacia arabica* var. *Kraussiana*, *Celastrus buxifolius*, *Hippobromus alata*, *Ehretia hottentotica*, *Jasminum multipartitum*, *J. sp.* (*Gerardi?*), *Elaeodendron aethiopicum*, *Zizyphus mucronata*, *Grewia caffra*, *Acacia caffra*, *A. horrida*, *Randia rudis*, *Xanthoxylon capense*, *Combretum Kraussii*, *C. salicifolia*, *Nuxia oppositifolia*, *Roxena pallens*, *Pavetta lanceolata*, *P. sp.*, (*obovata?*), *Cussonia spicata*, *Helinus ovata*, *Gymnosporia* (*Celastrus*) *sp.*, *Brachylaena discolor*, *Dovyalis* (*Aberia*) *tristis*, *Azima tetracantha*, *Euclea undulata*, *E. lanceolata*, *Calpurnia sp.*, *Rhus spp.* Climbing on these plants are various lianes: — *Dalbergia obovata*, *Vitis cuneifolia*, *V. cirrhosa*, *Clematis brachiata*, *Asparagus sp.*, *Dalechampia capensis*, etc. The undergrowth is rich in herbaceous forms: — *Sansseriera thyrsiflora*, *Lippia asperifolia*, *Barleria obtusa*, *Scilla sp.*, *Rubus rigidus*, *Vernonia corymbosa*, *Melasma sp.*, *Kalanchoe rotundifolia*, *Cyathula sp.* and, near the riverbed, *Setaria imberbis*, *Pennisetum unisetum*, *Cyperus spp.*, etc.

Acacias, especially *Acacia horrida* and *A. arabica* var. *Kraussiana* are the chief pioneer species. The author shows that, by their structure, these plants are adapted to unshaded localities where there is no protection against grass fires. These trees prepare the way for other species which follow and establish themselves under their shade, where they find

the soil well-prepared by the activity of earth-worms, termites and ants. There are various stages of vegetation and subsequent species may kill the pioneer. As a rule, however, the thorn-trees predominate in the Thorn Scrub, which at present forms the final stage over most of the areas.

The author gives a list of over 230 species of trees, bushes and lianes of the Thorn Veld, showing their frequency and the undergrowth. He distinguishes three important sub-formations: the Thorn Veld near the coast, that of rocky land, and that of the stream banks; the last two may be considered as distinct formations.

The question of seed distribution is discussed. Wind distribution is of relatively small importance. The chief agents of dispersal are birds, but for species with capsular fruit and small seeds, ants, which abound in the Thorn Veld, are also important.

850 - **The Glandular Pubescence of Several Species of *Medicago*: Observations made in California, U. S. A.** - McKee, R. (Office of Forage-Crop Investigations, Bureau of Plant Industry, U. S. Dept. of Agric.), in the *Journal of the American Society of Agronomy*, Vol. X, No. 4, pp. 139-162. Washington, March 20, 1918.

Many varieties of *Medicago* have been classified as sub-species on the basis of the presence or absence of the glandular pubescence, but the author's data show that, in certain varieties, this pubescence varies markedly with the environmental conditions. It can, therefore, not be adopted as a constant character in the determination of sub-species.

Field observations made during many years on several plants of *M. orbicularis* and its sub-species showed that, at the beginning of the season, none had pods with glandular pubescence, whereas later, after several hot, dry days, all the plants and all the pods, young and old, were strongly pubescent.

Some forms of *M. lupulina* are smooth and others hairy all their lifetime; most of them show the same variation, due to environment, as the preceding species (hot and dry weather, dry soil).

*M. falcata*, introduced into the United States, has a marked pubescence in one of its forms only - *M. falcata viscosa*; *M. sativa* is glabrous. Nevertheless, some plants of both these species show glandular pubescence. For this reason the author regards them as hybrids, although they show little variation in their other characters.

*M. hispida*, *M. Echinus*, *M. obscura helix*, *M. intertexta*, *M. tuberculata aculeata*, have a microscopical glandular pubescence on the pods at the beginning of the season, but lose it towards the end of the season.

851 - **Behaviour of Sweet Potatoes in the Ground.** - HASSELBRING, H. (Bureau of Plant Industry, U. S. Dept. of Agric.), in the *Journal of Agricultural Research*, Vol. XII, No. 1, pp. 9-17 + 1 Diagram. Washington, D. C., January 7, 1918.

In the course of previous investigations on the behaviour of sweet potatoes in storage, it was observed that the percentage of starch was always highest and the percentage of sugar lowest in freshly dug potatoes. The constancy of the condition seemed to justify the conclusion that in the growing sweet potato the reserve materials exist essentially in the form

of starch, and that the appearance of sugar in considerable quantities is a phenomenon occurring only in storage or after the destruction of the leaves.

In order to determine whether these quantitative relations between the starch content and the sugar content of the sweet potato remain constant throughout the latter part of the growing season, and to what extent they are changed by the death of the vines, the carbohydrate metabolism in Big Stem sweet potatoes was followed from the time the roots were large enough to furnish the requisite samples (end of August to beginning of September) until they were seriously damaged by frost. From the numerous analytical data given in three tables the following deductions are drawn for September 18 and 25, October 2, 9, 17, 23, and 30, November 6, 13, 20, and 27, respectively:—moisture (per cent):—73.92, 73.24, 73.87, 75.47, 76.30, 77.43, 77.78, 75.99, 78.14, 77.78, 78.93; starch (this percentage as well as the following ones are on a dry matter basis):—71.39, 72.39, 70.90, 69.28, 69.44, 68.51, 64.65, 63.58, 55.27, 50.73, 46.20; saccharose:—7.93, 7.52, 8.81, 8.58, 8.31, 8.86, 11.24, 13.75, 18.40, 23.11, 26.06; reducing sugar as glucose:—1.44, 1.22, 1.72, 2.23, 2.81, 2.80, 3.16, 2.69, 3.29, 3.20, 3.85; total carbohydrates:—80.76, 81.13, 81.43, 80.09, 80.57, 80.18, 79.05, 80.02, 79.96, 77.03, 76.11.

Thus the *moisture content* of the roots was almost uniform from September 18 to October 2, after which it gradually increased till the end of the season. The percentage of *starch* in the dry matter of the roots decreased slightly from September 18 to October 23, and then with increasing rapidity till the end of the season. The rapid disappearance of the starch follows, with a little delay, on the death of the leaves. The *saccharose* content remains practically constant between 7.52 to 8.86 till the rapid decrease of the starch, when it begins to increase correspondingly till it finally represents 26.06 % of the dry matter of the roots. As a rule the changes in cane sugar begin somewhat later than those of the starch. The *reducing sugar* first remains constant, then rises gradually, till the final percentage is slightly more than double the initial one. The increase in *reducing sugar* somewhat precedes that in cane sugar; this increase is less in sweet potatoes left in the ground than in those in store. The *total carbohydrates* undergo little change till towards the end of autumn, when the roots begin to show injury from frost, which causes evident loss of carbohydrates.

**CONCLUSIONS.**—The changes occurring in the roots of sweet potatoes left in the ground during the end of the growing period proceed regularly. When, on the death of the leaves, transpiration and the flow of material into the epigeal part ceases, the accumulation of water in the roots and the transformation of starch into reducing sugar and from that into saccharose begin. In stored and cured sweet potatoes there is considerable loss of carbohydrates due to respiration, whereas if the roots are left in the ground such loss is insignificant till the roots have been injured by frost. The accumulation of water in roots left in the ground is detrimental to their keeping qualities. It is precisely to reduce this moisture content

that the sweet potatoes are cured, thus giving a product which is generally acknowledged to keep better. It is of the utmost importance that sweet potatoes be not left in the ground after the leaves have been killed by frost.

852 - **Comparison of the Hourly Evaporation Rate of Atmometers and Free Water Surfaces with the Transpiration Rate of *Medicago sativa*** (1).—BRIGGS, LYMAN J. (Biophysicist in Charge of Biological Investigations) and SHANTZ, H. L. (Physiologist, Alkali and Drought Resistant Plant Investigations, Bureau of Plant Industry, U.S. Dept. of Agric.), in *Journal of Agricultural Research*, Vol. IX, No. 9 pp. 277-292, 4 Fig. + 3 Plates, Bibliography of 11 Publications. Washington, D. C., May 28, 1917.

The rate of evaporation from a free water surface or from a moist porous surface is usually considered the single-valued expression of the intensity of the weather factors influencing transpiration. Such a relationship is, however, subject to the uncertainty arising from the marked differences in the energy-absorbing and energy-dissipating properties of the transpiring and evaporating surfaces. It is evident that the transpiring and evaporating surfaces must be in agreement in this respect if the departure of transpiration from evaporation during the day is to be taken as evidence of a change in the transpiration coefficient, resulting from stomatal control or other reversible changes within the plant body.

Fluctuations in transpiration from day to day appear to be reflected with approximately the same degree of fidelity by a number of widely different forms of evaporating surfaces, provided precautions are taken to maintain the uniformity of these surfaces throughout the period of observation. When the hourly transpiration rate is under consideration, however, the individuality of the evaporating surface to which the transpiration is referred cannot be ignored. It is this phase of the question that forms the subject of the present paper, which deals with a comparison of the hourly transpiration rate of alfalfa with the hourly evaporation rates from various types of porous cup atmometers, a filter-paper evaporimeter, a blackened, shallow tank, and a deep tank.

The comparison between the transpiration rate and the evaporation rate was made by superimposing the hourly transpiration graph on each of the hourly evaporation graphs, choosing the scale of ordinates of the transpiration graph so that the total area under the transpiration graph was equal to the total area under the evaporation graph. The average hourly departure of each of the evaporation graphs from the superimposed transpiration graph expressed in percentage of the mean transpiration for the day was then determined. For the shallow tank the mean hourly departure for the 24-hour period was 17 per cent; for the filter-paper evaporimeter 31 per cent; for the brown cylinder, white sphere, and Bellani plate about 40 per cent; for the white cylinder about 50 per cent; and for the deep tank about 90 per cent of the mean hourly transpiration. The corresponding departures for the daylight hours from 6 a. m. to 6 p. m. were as follows:—For the shallow tank, 12 per cent; filter-paper evaporimeter, 22 per cent; brown cylinder,

(1) See also R. February 1917, No. 131. (P<sup>2</sup>).



white sphere, and Bellani plate atmometers, about 30 per cent; white cylinder atmometer, 38 per cent; and the deep tank, 93 per cent. Since the hourly evaporation graphs of the various evaporation systems employed differ widely in form, it does not seem justifiable to attribute the discrepancy between the observed hourly transpiration and that calculated from the evaporation rate of any particular system to a change in the transpiration coefficient of the plant during the day, unless it can be shown that under less extreme conditions the transpiration rate is in accord with the evaporation rate. The plant may not be responding freely to its environment, but a departure in its relative transpiration rate from the evaporation rate of an arbitrarily chosen physical system does not necessarily establish this fact. A close correspondence does not appear to exist between the hourly transpiration rate of normal alfalfa plants and the hourly evaporation rate of any of the systems employed in this investigation. The best agreement in this instance was obtained with the shallow, blackened evaporation tank.

The departure of the hourly evaporation rate of the porous-cup atmometer from the hourly transpiration rate of alfalfa is due largely: — 1) to the marked increase in the evaporation over transpiration during the night hours; 2) to the marked response of the atmometers to changes in wind velocity, which were not accompanied by corresponding changes in the transpiration rate; and 3) to the lack of a proportionate response on the part of the atmometers to changes in solar radiation.

It should be emphasised in this connection that the failure of an evaporating surface to show a high correlation with the hourly transpiration rate does not necessarily imply a correspondingly low correction on the daily basis. This is strikingly illustrated by the hourly evaporation rate from the deep tank, which, in these experiments, shows practically no correlation with the hourly transpiration rate, but which on a daily basis was found in 1914 to be correlated with the daily transpiration rate to the extent of  $0.63 \pm 0.01$ .

853 — **The Influence of Certain Organic Substances on Plant Growth.** — CIAMICIAN, B. and RAVENNA, C., in the *Atti della Reale Accademia dei Lincei*, Series 5, *Rendiconti*, Vol. XXVI, First Half-Year, Part 1, pp. 3-7. Rome, January, 1917; Vol. XXVII, Part 7, pp. 38-42. January, 1918.

The authors describe experiments on the influence of certain organic substances on plant growth, especially with kidney-beans germinated and grown on absorbent cotton.

The substances tested were — mandelic nitrile; benzylic and salicylic alcohols as potassium salts; vanillin; eugenol; tannin; acid amides, alanin and asparagine; uric acid and xutilin as potassium salts and compared with caffeine; pyridine and piperidine compared with nicotine; quinine, strychnine and morphine.

In the germination tests the seeds were placed on cotton in galvanised-iron germinating trays the bottom of which was covered with filter paper, and moistened with a solution at 1 per 1000 strength of each of the above mentioned substances. Mandelic nitrile, eugenol, and mustard oil completely prevented the kidney-beans from germinating; the other substances

were, however, less toxic for germinating seeds, and, on the contrary, even alanin and strychnine, and, to a less degree, cocaine, atropine, quinine and morphine, caused a germination that was premature in comparison with that of the seeds moistened with water. Vanilline, tannin and asparagine neither retarded nor hastened germination. Mandelic nitrile and strychnine had an antithetic action, considering that, when the seed was moistened simultaneously with both the solutions, some germinated, viz. 3 % for the kidney-bean and 26 % for the lupin.

When the young plants had grown sufficiently, they were given the various solutions at 1 per 1000 strength. It was found that the plants in the galvanised-iron germinating trays suffered less from the toxic substances than those in glass trays and that zinc sulphate hinders the toxic action of the aromatic compounds.

Except mandelic nitrile, the other aromatic compounds used had no specific action on the kidney-bean plants so as to modify their external morphology. On the contrary, however, kidney-bean plants fed exclusively on mandelic nitrile alone or with that substance plus a nutritive solution free from nitrogenous compounds, were shorter and more squat, with the roots less developed, rounder leaves and of a deeper green colour, in comparison with control plants in a nutritive solution. Nevertheless these differences became attenuated as growth continued, disappearing at maturity. The eugenol was very noxious; the saligenine, benzylic alcohol, sodium benzoate and salicylate at first caused some harm, which later disappeared; vanilline and tannin had no effect; alanin and asparagine had a favourable action.

Whilst pyridine and piperidine only result in a darker colour of the leaves, all the vegetable alkaloids properly so-called, which were tried by the authors, had a toxic action. Thus, while caffeine (trimethylxanthine) kills kidney-bean plants in 2 days, xanthine and uric acid favour their growth; thus proving that methylic radicals can also cause a strong physiological action in plants, which the fundamental compound entirely lacks. These facts are in contradiction with the opinion of those who consider the alkaloids are excretory products, and the methylic radicals, so common in plant products, as a means of protection for weakening the action of too active radicals such as oxyhydrides or imines. Of all the alkalis used in this research, the least toxic was morphine; quinine was more toxic and strychnine still more so.

According to the authors, the known facts point to the hypothesis that alkaloids have, in the plant organism, a function as yet unknown and undetermined, which might be that of plant hormones. The various species of plants, in order to take advantage of the inutilisable waste products as such, might change their composition so as to make them suited to the specific functions which they should fulfil, just as animals, for example, produce the adrenalin of the supra-renal capsules by means of tyrosine.

As regards the faculty of plants to free themselves of useless or harmful substances, the authors record that on inoculating young maize plants

growing in the open soil with the tartrates of nicotine and pyridine, and by keeping the upper part of the plant closed in a flask whose walls were damped with dilute sulphuric acid, they were able to show that the two alkaloids left the leaves by transpiration. Admitting that plants are not unprovided with elimination systems, if very active substances are found to be present in them, that signifies that the plant has produced the substance with some definite purpose.

854 - **Selected Wheat in India.** — MACKENNA, J., in *Report on the Progress of Agriculture in India for 1916-1917*, pp. 17-20. Calcutta, 1918.

The improvement of wheat by selection and hybridisation has been steadily studied and has already given excellent results. In the various provinces of India the old native forms are gradually being replaced by more productive new varieties, distinguished by the superior quality of their grain.

*Pusa No. 12*, early, resistant to rust and lodging is very popular among farmers and widely grown in the United Provinces, Punjab (Hoshiarpur, Jullundur, Gurdaspur, and Sialkot districts), as well as in South Bihar.

*Pusa No. 4* does well in Bundelkhand, Central India, and especially in the North-West Frontier Province, where it is much superior to the native types in yield and resistance to rust and lodging.

*Pusa No. 12* and *Pusa No. 101* are successfully grown in the Central Provinces, Southern Circle. In the Northern Circle No. 13 is preferred in the Nerbudda Valley, No. 88 in Jubbulpore, and No. 90 where irrigation is used. Hybridisation work (EVANS) is being continued between the local varieties and an Australian variety with the aim of obtaining types yet more resistant to rust.

At the Pusa Experiment Station, where most of the new wheats come from, Mr. HOWARD is continuing his selection and hybridisation work. At present four series of crosses are being studied, two of which, derived from *Pusa No. 6*, have already given promising results. The work aims at combining in one type to the best advantage, good root development, resistance to rust and lodging, good quality grain, and a high yield.

The selected wheat *Punjab 11* is being grown more and more in the irrigated districts of the Punjab. Owing to the good quality of its grain and its high yield, this wheat assures the farmer a good profit. *Pusa No. 12* is grown in this district as well as *Punjab 11*.

In the United Provinces Mr. LEAKE has evolved a new variety, *Cawnpore No. 13*, with very strong straw and grain of good milling qualities.

855 - **Selection of Native Oats and Barley in Norway.** — CHRISTIE, W., in *Aarsberetning anstalten de offentlige forsøksstationer til landbruks fremme i aaret 1916*, pp. 481-515 + 2 Tables. Christiania, 1917.

The varieties of cereals selected in England, Denmark, and Germany cannot be cultivated in Norway because of its different weather and agro-geological conditions; they have been repeatedly tested but have always given negative results on account of their lateness. Good results have, however, been obtained with some of the best types from Svalöf (Sweden), de-

rived from the hybridisation of selected varieties with local ones characterised by their earliness and resistance to cold. Thus, for example, in 200 cultural tests in various districts white Guldregn oats (1) always gave excellent yields of grain and straw. All the Svalöf varieties are, however, very exacting as regards soil, and when sown in the shallow, sand or peat soils so common in Norway they tiller little and yield less than the native Romerike, Trönde, Hedemarken and Vestland varieties. It is, therefore, necessary to select the native types so as to improve them and fix new strains with well marked, stable characters, capable of being crossed with the productive, ultra-selected foreign varieties.

Norwegian oats and barleys include numerous forms differing in yield, strength of straw, earliness, etc. Selection of the best elements is sure to lead to the formation of groups with valuable characters, better developed and superior on the average to the native varieties both in yield and earliness. The paper under review gives the results of pure-line selection of Norwegian oats and barley.

OATS. — In 1905, 127 Hedemarken plants were selected at Vindju, in Ringsake, and, in 1906, 170 plants of the same variety in different parts of the province of Furnes. It should be noted that among the native oats there frequently occur forms of the Propsteier type which was previously largely cultivated in this district. During the years following the first selection a comparative study of the various strains was made and the least promising ones eliminated, thus gradually reducing the number of plants in 1912 to 4 only *i. e.*, 2 from the 1905 selection and 2 from the 1906 selection. The names of the new varieties and the numbers in which they are inscribed in the genealogical register are: — Möistad Grenader, 34, Möistad Odin 0200, Möistad Perle 160, Möistad Thor 0207. During five years they have been subjected to comparative cultural tests with the native Hedemarken variety and the Swedish oats Guldregn and Mesdag. The grain yields (cwt. per acre) are given in Table I.

TABLE I.

	Möistad Grenader 34	Möistad Perle 160	Möistad Odin 0 200	Möistad Thor 0 207	Hede- marken (native)	Guldregn (Swedish)	Mesdag (Swedish)
In soil uncultivated the previous year .	20.47	20.78	24.61	24.61	22.30	21.26	19.67
In soil previously man- ured and planted with potatoes . .	24.37	20.63	24.29	23.65	21.26	22.78	18.95

In rich soil previously fertilised and planted with potatoes Grenader and Odin did best, but in soil not cultivated the previous year Thor and

(1) See *B.*, 1912, No. 1030, 4*Ed.*

Odin took first place. In all cases Odin yields best. The results obtained are shown in Table II.

TABLE II. — *Results of comparative cultural experiments with different varieties of oats and barley at Hjellum and Møistad.*

	Duration of vegetative period (1)	Resistance to lodging (2)	Yield in grain per acre	Relative index of yield in grain	Weight of 1000 grains	Percentage of hulled grain	Yield in straw per acre
	days		cwt.		gm.		cwt.
<i>Oats:</i>							
Grenader 34 . . . .	108	1.2	20.47	83	48.59	77	34.09
Perle 150 . . . .	97	1.4	20.78	84	34.65	73	31.69
Odin 0200 . . . .	107	1.9	24.61	100	45.24	74	33.93
Thor 0207 . . . .	105	2.8	24.61	100	39.22	68	34.52
Hedemarken (native)	104	3.7	22.30	91	35.21	70	34.48
Guldregn (swedish) .	105	1.6	21.26	86	42.24	76	36.63
Mesdag (swedish) . .	(98)	3.2	19.67	80	(34.56)	(72)	27.95
<i>Barley:</i>							
Mjøs . . . . .	90	3.00	18.63	100	43.63	—	27.31
Maskin . . . . .	86	1.25	17.92	96	38.23	—	21.90
Bamse . . . . .	88	3.16	17.12	92	37.39	—	25.09
Hedemarken (native)	89	4.00	17.28	93	35.81	—	25.17

(1) Number of days from sowing to harvest. — (2) This resistance is expressed according to an empirical scale ranging from a maximum of 1 to a minimum of 4.

The results are very satisfactory for all the characters considered and the four new varieties are very superior to the original ones. The resistance to lodging (1.2) of the Grenader variety is nearly three times that of the Hedemarken variety (3.7). The vegetative period of the Perle variety does not exceed 87 days. The varieties Odin and Grenader surpass even the Swedish Guldregn variety in the weight of 1000 grains. Finally, in percentage of naked grain Grenader again leads with 77 %, exceeding Guldregn by 1 % (76). The data on the four new varieties may be summarised as follows : —

1) *Grenader 34*. — Comes first for resistance to lodging, percentage of hulled grain and, in rich, fertilised soil, yield in grain. The bright yellow grain is of the Propsteier type, short, compact, and plump. This variety has been put on the market since 1917.

2) *Odin 0200*. — A very productive variety, not only in Hedemarken, but also in the province of Romsdal. Grain of the Propsteier type. On the market since 1917.

3) *Thor 0207*. — In the provinces of Hedemarken, Romsdal and Trøndelag this variety is very productive, even in very poor soils and has at the same time a high resistance to lodging. It is certain to be largely used in Norway owing to its capacity of adapting itself to unfavourable weather

and agro-geological conditions. White grain of the Norwegian type, large and plump. Will be put on the market in the spring of 1919.

4) *Perle* 160. — Remarkable for its earliness which even exceeds that of the Swedish Mesdag oats, famous for this quality. It is equal to Odin and Guldregn in its resistance to lodging. Grain pearl white of the white Norwegian type, very short; a little inferior in dimensions to the common Hedemark oats, but has a higher percentage of hulled grain. This variety cannot be put on the market for 3 or 4 years.

SIX-ROWED BARLEY. — Taking as a basis the considerations given above for oats the author made a first selection of 85 barley plants in 1905, and, in 1907, a second selection of 232 plants in the districts of Biörneby, Älv, Trysil, Lom, Hovinsholm, and Helgeöen. A series of comparative tests with the elimination of the more unpromising plants reduced the number of strains to two good new varieties *Miös* and *Maskin* — designated in the genealogical register by the numbers 08 and 077. The results obtained are compared in Table II with those of Bamse barley and unselected common Hedemarken barley. The results were distinctly positive, for the two varieties surpassed the original ones, especially in yield in grain and resistance to lodging. The two varieties may be described as follows: —

*Miös* 08 is distinguished by vigorous growth, high yield in grain and straw and size of grain. In earliness and strength of straw it is, however, equal only to common barley. It was put on the market in the spring of 1917.

*Maskin* 077 is remarkable for earliness (it ripens three days before common barley) and resistance to lodging; it also gives good yields.

856 - *Pure-line Selection of Oats and Barley in Quebec, Canada.* — MURRAY, JAMES, in *The Agricultural Gazette of Canada*, Vol. V, No. 2, pp. 163-165. OTTAWA, FEBRUARY, 1918.

By individual selection the author succeeded in isolating strains of Joannette oats differing in many ways from the parent plant; these strains are Nos. 407, 607, 2007, 2707, and 3307. The data given below are the averages of a five-year period.

The duration of the vegetative period for Joannette is, on the average, 99.2 days; No. 2007 is, however, much earlier, 94 days; No. 407 is much later than the original variety, 105.6 days.

The percentage of hull, 26.9 for Joannette, is 28.8 for No. 2007 (an undesirable character), but drops to 24.4 for No. 3307.

Yield in grain. — Joannette yields 59.67 bus. per acre; it is exceeded only by No. 607 which yields 70.09 bus; all the other strains are more or less inferior to the original variety.

Still more satisfactory results were obtained with Mandscheuri barley, as is seen by the five-year averages for the original variety and the selected strains Nos. 6809, 7008, 7408.

Duration of vegetative period	Bushels of grain per acre
86.8 days	62.84
86.8 "	69.95
84.6 "	66.69
86.2 "	67.29

The pure strains give a higher yield than the original variety and one is equally early, whereas the two others are earlier.

**857 - Experiments in the Hybridisation of Maize, in the Philippines.** — MARQUEZ, P. D., in *The Philippine Agriculturist and Forester*, Vol. VI, No. 4, pp. 116-123. Los Baños (Laguna), December, 1917.

Maize hybrids are often more vigorous and more productive than the parent plants, so that hybridisation may be advantageously carried out whenever similar varieties are available so that, when crossed, they give uniform and homogenous progeny. The author made the following crosses: —

- I) First Prize Mestizo (357  $F_2$ ) ♀ × Iowa Ideal (1490  $F_1$ ) ♂
- II) White Flint Moro (2581) ♀ × Pasig White Flint (2298) ♂
- III) Pasig Yellow Flint (2802) ♀ × Old College Yellow Flint (184  $F_4$ ) ♂
- IV) Bay Moro White Flint (3149) ♀ × Native Yellow Flint (3150) ♂
- V) Pure Moro White Flint (3163) ♀ × Bay Moro White Flint (3145) ♂.

The Cross IV, between white and yellow varieties, gave lemon colour hybrids which yielded 21.5 % more than the Native Yellow Flint. The results of Cross V were also very good, the yield of the hybrids exceeding that of the parents by 15.4 %.

**858 - Lint Percentage and Lint Index as Important Factors in the Selection of Cotton Varieties.** — See No. 866 of this *Review*.

**859 - Investigations into the Colour of the Fruit in Hybrids of Tomato, Aubergine and Pepper, in the United States.** — BYRON, HALSTED D., in *The Journal of Heredity*, Vol. IX, No. 1, pp. 18-23. Washington, 1918.

**TOMATO (*Solanum Lycopersicum*).** — The pulp of the fruit may be either lemon colour (y), or red (R); the tegument may be of an orange shade (O), or colourless (o). The characters O and R are dominant, y and o are recessive. There may be four different combinations:—

- |  |  |
|--|--|
| 1) yellow pulp and colourless tegument: yellow fruit. yyoo |  |
| 2) " " orange " orange " yyOO                              |  |
| 3 Red " " colourless " pink " RRoo                         |  |
| 4) " " orange " red " RR00                                 |  |

The cross 1 × 2 gives, in  $F_1$ , hybrids all of which have orange fruit (yyOo) as a result of the dominance of O, and in  $F_2$   $\frac{3}{4}$  of individuals with orange fruit and  $\frac{1}{4}$  with yellow fruit, in accordance with the ratio 3:1.

Similarly the cross 3 × 1 gives an  $F_1$  composed entirely of pink-fruited hybrids (Ryoo), and an  $F_2$  including three pink-fruited plants. RRoo, Ryoo, yRoo and one yellow-fruited plant yyoo.

The cross 3 × 2 is less simple. In  $F_1$  the two dominant characters combine so that all the fruit is of a different colour from that of the parents, i. e., red, RyOo. These hybrids produce four kinds of gametes — RO, Ro, yO, yo — which combine in  $F_2$  in 16 different ways, as is seen by the appended figure, giving plants with red, pink, orange and yellow fruit respectively in the ratio 9:3:3:1.

		Male gametes of $F_1$				
		$\sigma$				
Female gametes of $F_1$	$\phi$		RO	Ro	yO	yo
	RO		RR00 (red fruit)	RR0o (red f.)	Ry00 (red. f.)	Ry0o (red f.)
	Ro		RR0o (red f.)	RRoo (pink f.)	Ryo0 (red f.)	Ryoo (pink f.)
	yO		yRRO (red f.)	yR0o (red f.)	yy00 (orange f.)	yy0o (orange f.)
	yo		yR0o (red f.)	yRoo (pink f.)	yyo0 (orange f.)	yyoo (yellow f.)
		Zygotes of $F_1$				

Crosses between type 4 and the others gave the following results:—

a) Cross  $4 \times 1$  (red fruit  $\times$  yellow fruit):—All the  $F_1$  hybrids have red fruit!  $F_2$  behaves as in the cross  $3 \times 1$  (see Figure).

b) Cross  $4 \times 2$  (red fruit  $\times$  orange fruit): The  $F_1$  hybrids all have red fruit (Ry00); they produce two sorts of gametes — RO and yO — which can combine in  $F_2$  in four different ways, three giving red fruit RR00, Ry00, yR00 — and one giving orange fruit — yy00 — so that  $\frac{3}{4}$  of the  $F_2$  plants have red fruit, and  $\frac{1}{4}$  orange fruit. The hybrids RR00 and yy00 remain constant, whereas Ry00 and yR00 continue to divide into plants with red fruit and those with orange fruit, in the usual ratio.

c) Cross  $4 \times 3$  (red fruit  $\times$  pink fruit): this case is similar to the preceding one except that in the cross red  $\times$  orange the constant character is that of the tegument (00), whereas here (red  $\times$  pink), it is that of the pulp (RR).

AUBERGINE (*Solanum Melongena*). — The most common colour of the fruit is purple, which, however, varies greatly in the different varieties, as may be seen from a comparison between the varieties Black Beauty and Dwarf Purple. In some cases this colour occurs beneath the calyx, in others only in these parts of the fruit exposed to the sun. There are, therefore, two pigments, distinguished by their manner of reacting to light. The fruit of plants which do not contain the factor determining the purple colour have a colourless tegument, and the ripe pulp may be either ivory white or green. There are, then, four cases to be considered:— a) green pulp; b) white pulp; c) purple tegument; d) colourless tegument. The characters "purple" and "green" appear to be dominant. Four combinations are possible:—

- 1) Green pulp and purple tegument: GGPP
- 2) White " " " " : ggPP
- 3) Green " " colourless " : GGpp
- 4) White " " " " : ggpp.

The cross  $1 \times 2$  gives, in all the generations, hybrids with constantly purple tegument. On the other hand, in  $F_1$  the pulp of the fruit is always



green, whereas, in  $F_2$   $\frac{3}{4}$  of the plants have fruit with green pulp (GG; Gg gG) and  $\frac{1}{4}$  fruit with white pulp (gg) in the usual ratio of 3:1.

In the cross  $1 \times 4$ , or GGPP  $\times$  ggpp, the hybrids of  $F_1$ , with the formula GgPp produce 4 kinds of gametes — GP, Gp, gP, gp. — which combine in 16 different ways, giving in  $F_2$ , 9 plants with green pulp and purple tegument (purple fruit), 3 plants with white pulp and purple tegument (pink fruit), 3 plants with green pulp and colourless tegument (green fruit); 1 plant with white pulp and colourless tegument (white fruit). These combinations give a figure similar to that for the tomato. These theoretical results may be obtained by crossing the variety Long White (white fruit) and the variety Dwarf Purple (purple fruit).

Besides the four types already discussed there is another with variegated fruit. When this is crossed with a white-fruited variety hybrids with slightly variegated fruit are obtained in  $F_1$ , but when it is crossed with a purple-fruited variety the hybrids of  $F_1$  have purple fruit, and in  $F_2$  most of the plants have purple fruit and only a few have variegated fruit, showing this second character to be recessive.

**PEPPER** (*Capsicum* spp.) — Before ripening the fruit may be light or dark green, when ripe, red or orange (red being dominant). In some cases, at the period of ripening, instead of an immediate change from green to red or orange, intermediate colours occur, such as a bright lemon colour, turning first to orange, then to red. In this case the more or less ripe fruit has many shades varying from green in the parts not exposed to the sun, to orange and red. This colour variation is due to a genetic factor which, at the time of ripening, determines the regular and immediate passage from green to red or orange. The most common colour combinations are: — 1) lemon and orange; 2) green and orange; 3) orange and red; 4) green and red.

Some pepper plants have a purple pigment especially in the nodes and stem, but sometimes in the flowers and fruit. Before ripening this appears black. Little is as yet known on the inheritance and genetic value of this character.

To sum up, in all the species considered the colour of the fruit tends to be yellow or red. In the tomato and aubergine the colour of the tegument is the fundamental character in selection and hybridisation tests. In the pepper plant various chromatic factors occur before the ripening phase, some of which are very similar to those of the aubergine. The purple colour occurs particularly in the fruit of aubergine. It is also common in that of pepper, but less marked in tomatoes. In each case it is very sensitive to the action of external agents.

860 — **The Cultivation of Cereals in Spain.** — I. QUINTANILLA, G., Cultivation of Cereals in New Castile, in *Boletín de la Asociación de Agricultores de España*, Year X, No. 105, pp. 60-84, Madrid, February, 1918. — II. DANTIN, CERECEDA, J., Experiments in the Dry Farming of Cereals in Spain, in *Boletín de Agricultura técnica y económica*, Year X, No. 112, pp. 316-325. Madrid, April, 1918.

I. — **CULTIVATION OF CEREALS IN NEW CASTILE.** — The great obstacle to an increased cereal production in this district is the climate (1). In

(1) See R. July, 1918, No. 725. (Ed.)

the provinces of Guadalajara, Cuenca and Madrid there are frosts every year from November to April or May: in that of Toledo, from November to March. During the last 15 years the minimum and maximum temperatures were  $-6.5^{\circ}$  and  $+40.4^{\circ}$  C respectively in the province of Toledo,  $-12.5^{\circ}$  and  $+38.5^{\circ}$  in that of Cuenca,  $-13^{\circ}$  and  $+39.6^{\circ}$  in that of Guadalajara, and  $-14^{\circ}$  and  $+40.5^{\circ}$  in that of Madrid. The differences are, therefore, considerable, and to these are added another unfavourable factor—snow during 8 or 9 months of the year. This accounts for the low yields. During the 10 years, 1903-1912, the average yields, in cwt. per acre, were:—Toledo, wheat 6.30 (this average, which is very low, includes the yield of irrigated wheat), barley, 13.38; oats, 9.55; rye, 4.38; Cuenca, wheat, 4.93; barley, 9.55; oats, 4.38; Guadalajara, wheat, 6.56; barley, 8.36; oats, 6.66; rye, 7.44; Madrid, wheat, 8.36; barley, 13.14; oats, 7.16; rye, 6.37. For the whole of New Castile the averages were:—wheat, 6.28; barley, 11.53; oats, 6.29; rye, 6.03. It is seen that all these yields are low.

On the other hand, rain is plentiful and well distributed—361, 477, 410, 417 mm. for the provinces of Toledo, Cuenca, Guadalajara and Madrid respectively.

There are three soil types in New Castile:—1) that from decomposing rocks, very silicious with only 6  $\frac{1}{100}$  to 7  $\frac{1}{100}$  of clay, and containing only 0.5  $\frac{1}{100}$  to 5  $\frac{1}{100}$  of lime (the larger amount in the Moucloua district), 0.6  $\frac{1}{100}$  of phosphoric acid, but up to 6  $\frac{1}{100}$  of potash; 2) calcareous soil not used for crops; 3) soil derived from feldspathic rocks with more than 1  $\frac{1}{100}$  of phosphoric acid, containing a fair amount of potash and nitrogen, but heavier than the soil of class 1.

In the experimental plots of the Agricultural Station of Alcalá de Henares the author found 12 to 14 % of moisture at a depth of 23  $\frac{1}{2}$  inches, and 9 to 11 % at the surface. There are also, however, at the Station sandy soils nearly 5 feet deep, which, at 2 feet, have barely 5 % of moisture so that plants can derive little from it. Experiments made at the Station showed that soil 5 feet deep and, if slightly heavy, 3  $\frac{1}{4}$  feet deep, is suitable for cultivation (according to WIDTSOE the requisite depth for sandy soils in the United States is 9.84 feet).

Judging by scientific observations and his own experience as a farmer, the author does not advise for the "Meseta Central" (central table-land) of Spain the dry farming methods usually recommended for dry soils, because he observed that in this district they dry up the soil instead of preserving its moisture. Instead he advises a single preparatory ploughing, as deep as possible, care being taken not to turn the sub-soil onto the surface.

The most satisfactory fertilisers are phosphatic and nitrogenous ones; as a rule little potassic fertiliser is required.

In view of the great climatic variations from one year to another it is impossible to lay down rules for the best time for sowing, but at any rate it should be sufficiently early to avoid injury from late frosts. With regard to the quantity of seed, in many parts of New Castile 187 lb. or more per acre are used. Cultivation consists of one or two hoeings to destroy weeds.

The author studies the different American wheats which, on the whole,

are adapted neither to the particular climatic conditions nor to the soil of New Castile.

II. — EXPERIMENTS ON THE DRY FARMING OF CEREALS IN SPAIN. — The author refers to the work done by Señor José Cascón at the "Granja agrícola" of Palencia and by Señor QUINTANILLA at the Miralcampo farm near Azuqueca, Guadalajara. The former concluded that the factor determining the quantity of seed to be used is not the nature of the soil, but the climate. At Palencia, where the average annual precipitation is 399 mm. the best quantity is 1.4 bushels per acre. With this quantity and good cultural methods the Agricultural Station of Palencia obtained, as a nine-year average, 21.38 cwt. of wheat per acre, or 3.27 times more than the average production (hardly 6.53 cwt.) for the whole of Spain (1). The amount of seed commonly used is excessive and sometimes exaggerated.

For more than a century excellent Spanish agriculturists have tested and recommended sparse sowing. AUGUSTIN CORDERO tested it near Madrid on behalf of the "Real Sociedad económica Matritense" and, in 1771, obtained for wheat, using 0.92 bushels of seed per acre, 18.88 bushels of grain; in 1772, with 0.74 bushels of seed, he obtained 21.88 bushels of grain. The seed was sown in lines in three rows with a space of one unsown line. In 1773, also with sparse sowing, he obtained 59.27 bushels per acre of barley using 1.96 bushels of seed, and 43.18 bushels of grain with 1.4 bushels of seed. The results of his experiments led him to recommend sowing in pockets, four seeds to each, in squares 1 foot apart leaving 1 line unsown to every 3. He based his calculations for the number of seeds to use on the work of VALCÁRCEL, who had already determined the number of seeds per unit of weight. In 1818 this method was confirmed and recommended by Prof. ARIAS Y COSTA in his text-book entitled *Leciones de Agricultura explicadas en el Jardín botánico* (Madrid, 1818).

861 — **Yields of Spring Grains in Illinois.** — BURLISON, W. L., and ALLYN, O. M., in *The University of Illinois, Agricultural Experiment Station, Bulletin*, No. 195, pp. 499-508. Urbana, Illinois, January, 1917.

Spring grains form a large proportion of the crops produced in Illinois. Owing to the marked climatic and soil differences in the State, varieties suited to one district are not necessarily desirable in another. The experiments described were carried out to determine the varieties best adapted to northern, central and southern Illinois, as represented by the experiment fields at Dekalb (Dekalb County); Urbana (Champaign County); Fairfield (Wayne County). The methods of culture used were similar to those of the corn belt.

(1) According to Prof. MARRO (*Curso general de Agronomía*, Vol. II, p. 152, Rome, 1904) the average wheat yield in Spain is 17.5 bushels per acre. According to Señor GUMERSINDO FERNÁNDEZ DE LA ROSA during the last 29 years, on an average about 10 of the 40 million acres of the arable land of Spain have been used for wheat, with an average annual yield, according to official statistics (which he considers higher than the actual yields), of over 115  $\frac{1}{2}$  million bushels, or 13.17 bushels per acre (*Revista de Montes*, Year XLII, No. 992, pp. 338-339. Madrid, May 15, 1918). (Ed.)

**NORTHERN ILLINOIS.** — (Soil: brown silt loam; rainfall: 33.64 inches per year): — The rotation was chiefly maize, maize, oats, and clover, but tests were also made with oats, spring wheat and barley in the rotation maize, oats, spring wheat and clover.

*Oats.* — Of the varieties tested for 6 years Silvermine, Schoenen and American Banner gave the highest yields with an average of 64.0, 63.3, 61.1 bushels per acre respectively. Great American, Scottish Chief and White Kherson (Iowa 103), tested for 2 years only, gave very satisfactory yields (70.8, 70.2 and 68.6 bushels per acre respectively). Tests made over 6 years with northern oats and home-grown oats showed that the first produced an average of 3.0 bushels per acre more than the second; this difference is not sufficiently great to justify the extra expense incurred by shipping northern seed oats.

*Spring wheat, barley, rye and emmer.* — The tests with these cereals have been too limited to justify any conclusions as to the relative value of the varieties.

**CENTRAL ILLINOIS.** — (Soil: brown silt loam; rainfall: 35.76 inches per year). — The crops were grown in two rotations, 1) maize, maize, oats or other spring grain, and clover; 2) wheat, maize, oats and clover.

*Oats.* — The best varieties tested over a number of years were:—

Variety	Average yield (bushels per acre)	Variety	Average yield (bushels per acre)
Sixty Day (11 yrs.). . . . .	58.1	Irish Victor (11 yrs.) . . . .	49.9
Swedish Select (6 yrs.) . . . .	54.6	Silvermine (8 yrs.) . . . . .	49.2
Schoenen (9 yrs.) . . . . .	51.1	Siberian (13 yrs.) . . . . .	49.0
White Bonanza (12 yrs.) . . . .	49.9	American Banner (13 yrs.) . .	47.0

The most promising of the varieties grown over 2 years only were: — Great American (72.1 bushels per acre), Yellow Kherson (Iowa 105) (68.9 bushels per acre), Big Four (68.8 bushels per acre), and Wisconsin Pedigree No. 1 (67.9 bushels per acre).

*Spring wheat.* — This crop is not ever likely to become important in Central Illinois, though it offers possibilities, especially where there is a danger of winterkilling. The results obtained in 1916 were: — Spring (a home-grown variety), 27.9 bushels per acre; Durum, 24.6 bushels per acre; Marquis, 21.8 bushels per acre; Red Fife, 18.3 bushels per acre.

*Barley.* — Common barley, with a 5 year average of 40.1 bushels per acre, seems the most promising of the varieties tested. It is very similar to Oderbrucker, which gave a 4 year average of 38.1 bushels per acre. The trials carried out so far are, however, insufficient to give any definite results.

**SOUTHERN ILLINOIS** — (Soil: grey silt loam on tight clay; rainfall: 40.25 inches per year). — Climatically southern Illinois is not well adapted to spring cereals, though, in favourable seasons, fair yields may be obtained. Texas Red and the early varieties of oats give better results than the late varieties.

The bulletin concludes with a table setting out the characteristics of the varieties of oats tested.

862 - **Researches on the Gases of Swamp Rice Soils, in India.** — See No. 843 of this Review.

863 - **The Recurving of Milo and Some Factors Influencing It.** — CONNER, A. B. and KAPER, R. E., in *Texas Agricultural Experiment Station, Bulletin No. 204*, 30 pp. + 10 Tables + 13 Figs. Austin, Texas, February, 1917.

Recurving or "goosenecking" in milo and certain other sorghums is undesirable on account of impracticability of harvesting the crop with machinery, and the probable reduction in yields by loss of heads during the early stage of development.

Climatic conditions at the Lubbock station, where experiments were conducted, were very favourable to the study of the fundamental cause, or causes, of recurving and the factors influencing it.

Tallness or dwarfness in the same strain is the result of lengthening or shortening of the internode. No apparent difference was observed in the tenderness of the peduncle of different grain sorghums at similar stages of development. In every case noted the normal inclination of the peduncle was toward the side of the leaf sheath opening. The removal of a vertical section of the back of the upper leaf sheath, however, always resulted in complete recurving of the peduncle in the direction of the opening, this fact indicating that the support from the leaf sheath alone controlled the direction in which the head inclined. Dwarfness in stature is associated with a high percentage of erect heads, while tallness is attended by a high percentage of pendant heads. Rapid growth of the plant is conducive to tallness, while slow growth is conducive to dwarfness. Root-pruning and consequent limitation of food supply increased the number of erect heads and decreased the number of pendant heads. Limitation of moisture and food of individual plants, by reducing the feeding area per plant, resulted in an increase in the number of erect heads and a decrease in the number of pendant heads. Measurements of internode and sheath lengths in both milo and kafir have shown that while the internode varies widely under different environmental conditions, the sheath length remains quite stable. A shortening or a lengthening of the internode without a corresponding change in the length of the sheath results in the sheath's overlapping the internode in varying degrees when the same plant is grown under different conditions. Long overlapping of the sheath undoubtedly lends support to the stem, including the peduncle, while a short overlapping of the sheath lends correspondingly little support. The removal of the inrolled sheath tip before any part of the head appeared resulted in increasing the percentage of erect heads. It seems conclusive that in milo a tightly inrolled upper leaf sheath tip influences the position of the head. Plants of tall stature showed a long inroll, as compared with dwarf plants, and long inroll of the upper sheath seems to be associated with a large number of pendant heads.

864— **Important Root Crops of the Philippines.** — KINGMAN, F. C. and DORYLAND, E. D., in *The Philippine Agricultural Review*, Vol. X, No. 4, pp. 410-433. Manila, 1917.

The following plants are largely cultivated throughout the Archipelago, usually as secondary crops. Their produce is on the market all the year round, and though the total production is unknown, they play an important part in the food supply of the population.

**GINGER.** — It is of good quality and consumed entirely locally. Besides *Zingiber officinale* 4 other varieties are cultivated. The yield per acre is from 4.77 to 7.16 metric tons of roots which lose 70 % of their weight when dried. It is sold coated or uncoated and scraped (decorticated when fresh and dried; this is "white ginger"). Ginger ale is made from a water extract of dried ginger root mixed with sugar, lemon juices, and yeast.

**ARROWROOT.** — Although all the different species used in the manufacture of arrowroot (*Maranta arundinacea*, *M. nobilis*, *Manihot utilissima* [cassava], *Canna Achiras*, *C. edulis*, *C. flaccida*), except *Maranta nobilis* and *Canna Achiras*, are grown in the Philippines, only *Maranta arundinacea* and *Tacca pinnatifida* are used largely. The former occurs wild in some localities. Under favourable conditions it yields 4.98 metric tons of roots per acre, which, with the local, crude processes of manufacture, yield 15 % of starch. The latter plant grows wild, especially near the coast.

**CASSAVA.** — There are many varieties in the Philippines, both bitter (*Manihot utilissima*) and sweet (*M. Aipi* = *M. palmata*), but they are not named. The average yield per acre is at least 9.95 tons of fresh roots containing 25 to 30 % of starch, 80 % of which is extracted by modern methods. Cassava does best in sandy soil, alone, at intervals of one year, in squares, or with a leguminous crop (cowpeas or mungos, etc.) between the lines, which should then be 5 feet apart. All the roots (sweet and bitter) contain hydrocyanic acid, which is removed by washing, drying, roasting or prolonged boiling. The roots are best for human food between 6 and 9 months after harvest.

**SINCAMAS** (*Pachyrhizus erosus* = *P. angulatus*). — A Leguminous vine, which has become acclimatised and grows wild in the Philippines. It is propagated from seed sown sparsely in rows about 23 inches apart, allowing from 15 to 20 seeds to the metre (3.28 feet). The plant matures completely in about 2 years, but is harvested 5 or 6 months after sowing, i. e., when the root, which is the edible part, is still tender and not yet fibrous. The yield is about 6 tons per acre.

**ELEPHANT EAR PLANT** (*Colocasia esculentum* = *C. antiquorum*), known locally as "gabi". The edible part is the starchy, acid stalk, or corm, the acid constituent of which is removed by boiling. The average yield is about 23 *cavans* (46.86 bushels) per acre.

Some years ago the Bureau of Agriculture of the Philippines made a collection of 21 species and varieties of gabi, most of which had to be discarded because of their liability to fungoid diseases.

**SWEET POTATO** (*Ipomoea Batatas*). — The sweet potato is known in the Philippines by the Mexican name of "Camote" under which it was

introduced centuries ago. There are several good-producing native varieties, but none of them are equal to the best varieties imported from North America, the best of which are New Jersey Yellow, known locally as Mommangan, New Jersey Red, and California Large White. The second variety holds the record for productivity, having yielded 256.78 cwt. per acre. In the Philippines the sweet potato is propagated by cuttings from young vines or, in sandy soil, by planting whole or half potatoes. When transplanting the plants are placed in the centre of the ridges (flat-ground planting gives low yields and bad-shaped roots, as was shown at the Singalong Agricultural Station). The best time for planting is towards the end of the rainy season, but if irrigation water is available the potatoes may also be planted during the dry season. Cultivation consists in working with a cultivator, followed by hoeing; it is rarely necessary to repeat the process. The most common diseases are mosaic disease, due to physiological causes, and rots of the tuber during storing. The most injurious insect is *Cylas formicarius*, which lays its eggs near the collar. The larvae bore holes in the root, where they pupate. Control measures consist in early harvesting, rotation, and the burning of all root refuse.

**YAM.** — In 1912 the Philippine Bureau of Agriculture collected 116 species and varieties of the genus *Dioscorea* from all parts of the Tropics, and cultivated them for several years. The 96 which became acclimatised were subjected to a complete chemical analysis, and to growing and feeding tests. Only 34 (10 varieties of *D. fasciculata*, 18 *D. sp.*, 1 *D. Daemona*, 4 *D. alata*, 1 *D. aculeata*) were considered adapted to Philippine conditions. These are being propagated for distribution purposes at the Agricultural Station of Linao, Bataan.

*D. fasciculata* grows wild in some parts of the Philippines. Propagation is by tubers or crowns of tubers in lines 2.36 to 3.28 feet apart at distances of 3.28 feet; trellises are erected later. The roots are harvested 7 to 9 months after planting. The production is equal to or better than that of the best varieties of sweet potato; some of the larger varieties yield nearly 23 metric tons per acre, but as they are difficult to harvest they are rarely grown.

A table is given showing the results of analyses made by the Bureau of Science of Manila of the roots of 96 species and varieties of *Dioscorea* grown in the Philippines. In most cases the tubers weigh about 500 gm. and contain about 70 % of water, 0.2 % of ether extract, 0.3 % of saccharose, 0.4 % of reducing sugar, 2 % of protein, less than 1 % of ash, about 20 % of starch, less than 1 % of fibre, and about 5 % of undetermined substances.

**865 - Cotton in Algeria in 1917** (1). — TRABUT, in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 16, pp. 512-513. Paris, May 8, 1918.

Owing to the difficulties of the present times cotton growing in Algeria is still localised in the Orleansville and Oranie districts. Nevertheless, very good results have been obtained. The only varieties cultivated

(1) See R. March, 1918, No. 243. (Ed.)

are derived from Egyptian cotton and the product, which is very good, commands high prices.

Two varieties selected by the Botanical Department from seed from the Yuma Station, California, have given good results.

The "Yuma" variety, selected from Mit-Affi, yielded at Orleansville 16.9 cwt. of raw cotton per acre. Under the same conditions Mit Affi yielded 13.5 cwt. per acre. At present prices a yield of 13.5 cwt. gives fibre worth £56 per acre. No other crop can give such good results in the Chélif plain.

At the Ferme-blanche Experiment Station the best results were obtained with a variety called temporarily "California", which proved there superior to Yuma, especially in earliness. This variety seems well suited to the soil and climate of North Africa.

For some years Egyptian planters have suffered much loss through injury done by the larvae of *Gelechia gossypiella*, which attacks the pods. The larvae hibernates in the seed and may be carried in it. As disinfection experiments with the seed gave unsatisfactory results, it is most important that no more seed should be imported from Egypt. At present sufficient selected seed is produced in Algeria to meet the local requirements. The Co-operative Society of Orleansville, the Cotton Association of Oran and the Ferme-blanche Experiment Station at Habra, are in a position to supply all the demands for seed in Algeria, Tunis and Morocco.

866 - **Lint Percentage and Lint Index of Cotton and Methods of Determination; Investigations in the United States.** — MELOY, G. S., in the *U. S. Department of Agriculture, Bulletin* No. 644, pp. 1-12 + 2 Figs. + 4 Plates. Washington, January 18, 1918.

The danger of diminishing the vitality and earliness of varieties of cotton by breeding those with undesirable characters by over-emphasising the percentage of lint as a measure of their comparative values was pointed out in 1908 by Mr. O. F. COOK (1). It has been suggested that instead of the percentage of lint only, the weight of lint ginned from 100 seeds should be used as an additional standard for judging varieties. This standard of comparison was called the lint index. Subsequent experience has shown not only the desirability of using this standard, but has also led to improved methods and apparatus for determining the lint index and the lint percentage in samples of seed cotton used by selectors.

The lint percentage is the ratio between the weight of the fibre and the weight of the seeds from which the fibre is ginned expressed as a percentage of the unginned seed cotton. The buyers of seed cotton were the first to use this lint percentage. It should be very carefully used if adopted by breeders and growers as a measure of the comparative value of varieties as it is misleading unless used in connection with the lint index.

An increase in the lint percentage may be due entirely to a reduction in the size of the seed without any corresponding reduction in the amount of fibre, and vice-versa.

(1) COOK, O. F., *Danger in Judging Cotton Varieties by Lint Percentages*, *U. S. Dept. Agr., Bur. Plant Industry, Circ. No. 11*, pp. 16, 1908. (Author).



The lint index is a measure of the abundance of the fibre rather than the measure of the ratio between the weight of the fibre and the weight of the seed, as for the percentage of lint.

The lint index shows the number of seeds and consequently the number of bolls, producing 1 lb. of fibre. The number of seeds and bolls required to produce 1 lb. of fibre is constant for all varieties of cotton having the same lint index regardless of the percentage of lint.

An increased lint index corresponds to an increase in the weight of the seeds and reduces the number of bolls required to produce 1 lb. of fibre.

The lint index is an important factor in the cost of production of cotton. An increase of a single gram in the weight of fibre per 100 seeds, without any change in the lint percentage, reduces the labour of picking cotton, thus increasing the amount picked by each worker. It is essential that a planter should know the lint index of a variety as well as the lint percentage when choosing a variety to be planted.

#### METHODS FOR DETERMINING THE LINT INDEX AND THE SEED WEIGHTS.

— After having weighed a standard sample of 100 gm. of seed cotton and determined the percentage of lint, which is the actual weight of the lint, the lint index and the weight of 100 seeds are obtained by the following formulae: —

$$\frac{\text{Percentage of lint}}{\text{Number of seeds in sample}} \times 100 = \text{lint index.}$$

$$\frac{\text{Percentage of seed}}{\text{Number of seeds in sample}} \times 100 = \text{weight of 100 seeds.}$$

The lint index may be determined as follows: — 100 average seeds fairly ginned are weighed on a sensitive balance, or still better, the average weight of two lots of 100 seeds is determined. The following formula may then be used: —

$$\frac{\text{Weight of 100 seeds}}{\text{Percentage of seed}} \times \text{lint percentage} = \text{lint index.}$$

A method is described by which the lint index and the size of seeds of a variety of cotton may be determined without a balance by means of tables given in the bulletin. A description is also given of a balance for the direct reading of the lint percentage. This balance is on the market.

867 - **The Cultivation of Gombo as a Textile Plant; Experiments in Mexico.** — *La Revista agrícola, Órgano oficial de la Dirección de Agricultura, Secretaría de Agricultura y Fomento*, Vol. 1, No. 10, pp. 398-400 + 2 Figs. Mexico, January 15, 1918.

This paper contains the results of experiments carried out a few years ago by Señor L. E. MARTINEZ at the Agricultural Station of Villa Hermosa, Tabasco, of which he was the director.

Gombo or "chimbombó", as it is called in Mexico, includes two species, the dwarf *Hibiscus abelmoschum* and the giant *H. esculentum*, which, in hot climates, reaches a height of nearly 10 feet.

This Malvaceae is very strong and adapts itself to the most varied climates (it only suffers from hard frosts) and to all soils. It does best, however, in sandy humus soils which have not long been cleared

of trees and in alluvial soils. In warm countries it can be sown throughout the year, in temperate countries in spring and summer. As the tegument of the seed is hard it is well, if possible, to irrigate before sowing, otherwise it is best to wait for the period following the first rains. If gombo is cultivated especially as a vegetable, *i. e.*, for its green fruit, it should be sown in lines 6  $\frac{1}{2}$  feet apart with 3  $\frac{1}{4}$  feet between the plants; if grown for its fibre these distances should be reduced by half. The only cultivation needed is hoeing. The plant begins to bear fruit 2 months after sowing. If the fruit, especially the first, is cut as soon as it forms, the plant develops better and in 6 months grows to a height of 10 feet or more; it should then be cut and not left till it loses its fine texture and sheen. The stalks, cut and put up in bundles, are macerated for 8 days; if possible the water should be renewed and the bundles washed frequently; finally they are rinsed in clean or soapy water and laid out in the sun to dry and bleach.

An ordinary sized gombo plant yields from 50 to 100 gm. or more of clean fibre, corresponding to 11 to 16 cwt. per acre. Before macerating the stalks the capsules are collected; the seeds obtained (4 to 8 cwt. per acre) yield an edible oil and a cake which may be used either as a concentrated food or as a fertiliser. Roasted they are used as a substitute for coffee. The tender fruit is prepared in various ways; cut in slices and dried in the sun it keeps till winter. The wood of the stalk and the fibrous covering of the capsule are excellent material for paper-making. The leaves and tender parts of the plant, if ensilaged, form excellent fodder for cattle; dried naturally they may serve as a substitute for tobacco, for they resemble it in appearance and when burning have almost the same smell.

863 - **Results of Growing Sweet Sorghum in Piedmont, Italy.** — JACOMETTI, G., in *Cronaca agricola, Organo Ufficiale dell'Associazione Agraria Piemontese*, Year XXIII, No. 9, p. 41 + 3 Plgs. Turin, May 16, 1918.

The author grew sweet sorghum at Villafranca Piemonte (province of Turin). On a plot 45  $\frac{1}{2}$  sq. yds. in size he obtained, as an average of several years, 220 lb. of stalks and 22 lb. of seed. The 220 lb. of stalks yielded from 90 to 120 lb. of juice, and from 99 lb. of juice were obtained from 15  $\frac{1}{2}$  to 17  $\frac{1}{2}$  lb. of sweet syrup. The author recommends the cultivation of this sorghum in Italy, especially for the preparation of the syrup for home use (simply by concentrating and removing the scum).

869 - **Plants Suitable for Paper-Making in South Africa.** — LEIGHTON J., in *The South African Journal of Science*, Vol. XIV, No. 6, pp. 287-289, Cape Town, January, 1918.

South Africa can furnish large quantities of Tambookie grasses (*Andropogon* spp.) suitable for making paper pulp. Samples of such paper, prepared by BERTRAMS, Limited, of Edinburgh, were quite satisfactory. The commonest Tambookie grasses are *A. hirtus*, growing to a height of from 2 to 3 ft., and *A. Nardus*, growing to a height of 5 or 6 ft. The former species is common throughout South Africa, while the latter occurs in patches adjoining forests and in moist places.

*Cyperus textilis* and *C. hexangularis*, common near rivers and wet localities in South Africa, produce a very strong paper; 5 to 10 % of their pulp mixed with Tambookie grass pulp produces an extra strong paper.

Among other plants suitable for paper-making are: *Sansevieria thyrsiflora*, an underbush plant common in the eastern regions; *Fleurya peduncularis*, a nettle common in moist places; *Agave americana*, introduced all over the country; maize cob husks and plantain fibre.

870 - **Investigations into the Autumn Growth of Fruit, in Italy.** - MANARES, ANGELO, in *Il Coltivatore*, Year LXIV, No. 9, pp. 180-183, and No. 12, pp. 246-248 + 1 Diagram. Casale Monferrato, 1918.

The experiments described were carried out by the author in an orchard at Imola planted in 1903 with pears (*Curato* and *Bergamotta Esperen* varieties) grafted on quince, with apples (*Reinette*, *Belle fleur jaune*, *Rosa romana*, *Garofana*, *Rosmarina* varieties), grafted on doucine and quinces (*Van Demon* and *Géante de Vranja* varieties) grafted on stock sprung from seed.

The author summarises the results of his investigations carried out to verify the studies of RIVIÈRE and BAILHACHE in France (1) and of WHITEHOUSE in the United States (2), according to whom winter pears, like apples, grow most during the period immediately preceding harvest.

1) The volume (and, naturally, the circumference as well) increases till a little after mid-October for winter pears, till after mid-November for late apples. Quinces are intermediate between the two, but resemble pears rather than apples. Consequently it would be well to bear these facts in mind when gathering these fruits unless other circumstances make an earlier harvest preferable.

2) The development curve of these fruits shows clearly that, contrary to the results obtained by the above mentioned workers in France and America, growth decreases as the season advances.

3) The specific weight of these fruits continually decreases during the last weeks before they fall.

4) The growth of the fruit depends on their more or less favourable situation and the number of fruits on the branch or on the plant.

871 - **The Common Honey Bee as an Agent in Plum Pollination.** - HENDRICKSON, A. H., in the *College of Agriculture, Agricultural Experiment Station, Berkeley, California*. Bulletin No. 291, pp. 213-235 + 13 Figs. Berkeley, January, 1918.

The results of these experiments, which are a continuation of those of the preceding year (3), may be summarised as follows: -

The average yield per tree of French (Agen) plums was increased by the use of bees in the orchard, but there was no increase in the yield of the Imperial variety. The percentage of setting was greatly reduced for both varieties when all pollen-carrying insects were kept away from the trees. The percentage of setting in a French plum tree enclosed in a tent of mosquito netting with wooden supports alone or with an Imperial tree and a colony of bees was higher than the orchard average for the variety. An Imperial

(1) G. RIVIÈRE and G. BAILHACHE, Etude sur l'accroissement du volume des fruits (*Journal de la Société nat. d'Horticulture de France*, December, 1917). - (2) W. E. WHITEHOUSE, A Study of Variation in Apples During the Growing Season (*Oregon Station Bull.* 134, 1916, 3-17) (Author). - (3) See *R. June*, 1918, No. 649. (Ed.)

tree gave a good crop when alone in a tent with bees, but a slightly higher yield than the orchard average when enclosed with a French plum tree and bees. The French plum tree which had given a heavy crop in 1916 when enclosed in netting with bees, gave a very light crop in 1917 when left free. A plum tree which had given a small crop in 1916 when under a tent alone, gave, in 1917, a percentage of setting which was satisfactory although below the general orchard percentage. Both the Imperial trees which had given a small yield in 1916, gave heavy crops in 1917 under open orchard conditions. The percentage of setting of the French varieties was in inverse proportion to their distance from the Imperials.

The results of the two year's work led to the following conclusions: —

- 1) Both French and Imperial plum trees set better if hives are placed in the orchard during the flowering period, provided the trees are in normal healthy condition.
- 2) If there are no bees in the orchard the percentage of setting of these varieties may be low.
- 3) The French plum does not absolutely require to be interplanted with the Imperial, though such interplanting may prove beneficial to both varieties.

872 - **The Mulching of Orange Groves in California and its Effects.** — See No. 846 of this Review.

873 - **The Chasselas × Berlandieri 41 B. Vine in Sicily.** — PAULSEN, F., in *Le Progrès agricole et viticole*, Year XXXV, No. 16, pp. 357-360. Montpellier, April 21, 1918.

For some years Sicilian vine-growers have re-constructed their vineyards with two stock only: — Aramon × Rupestris Ganzin No. 1 and, by preference, Rupestris du Lot. They should realise that other hybrids may be used many of which, especially those of Berlandieri, are superior to Rupestris du Lot under certain soil conditions.

One of these, little known and little used in Sicily, is Chasselas × Berlandieri 41 B, a hybrid created by MILLARDET which was successfully used in reconstituting the Charente vineyard in France, in a district where there is a predominance of tertiary limestones, which are most apt to cause chlorosis. Under these very difficult conditions of growth the most reliable and satisfactory reconstitution of these vineyards, planted with Folleblanche, which give the best cognac of world-wide fame, was obtained with 41 B.

Chasselas × Berlandieri was not readily used in the foremost Sicilian experimental yards because there were numerous phylloxera growths on its roots and its resistance in the Sicilian climate was doubted. Time, however, has shown that in spite of its susceptibility to phylloxera it is sufficiently resistant. The author has never seen it die either in stock plantations or even in the oldest experiment fields. He considers it a stock which might be advantageously used for reconstituting Sicilian vineyards if it is judiciously employed and adapted particularly to the conditions it prefers. It is especially suited to very calcareous soils with marly sub-soil. In the Sicilian climate it resists well in soils containing 80 to 90 %

of lime. The author has also observed it in very good condition in calcareous loam and even in sandy loams where clay predominates without any trace of lime. It should not be used in arid, poor soils and those retaining an excess of water which are cold and wet in spring. The soils which suit it best are those which warm rapidly but have a cool sub-soil.

It did well in the Marsala experiment vineyards in ground with rich calcareous marly sub-soil, but failed in dry soil the sub-soil of which consisted of arid calcareous tufa. Excellent results were obtained with it in the experiment field of S. Giuseppe Lata, on the estate of Prince CAMPOREALE in calcareous loam, and it also does well in the stock yard of the Royal Nursery of American Vines in the Luparello district, in rather heavy sandy loam.

Chasselas  $\times$  Berlandieri 41 B is very satisfactory for budding and has a good affinity for most of the local vines. It is one of the plants most resistant to bramble-leaf disease.

**874 - The Influence of the Stock and Other Factors on the Quality of the Wine: Experiments Carried Out in Sicily.** — PAULSEN, F. and MAGGIORI, N., pp. 47 + 3 Tables + 4 Diagrams. Palermo, 1915. Abstract in *Le Progrès agricole et viticole*, Year XXXIV, Nos. 42 and 43. Montpellier, 1917.

The results of comparative experiments carried out at Marsala from 1907 to 1912 are given: —

1) The quality of the wine depends in part only on the scion and the stock and much more on other conditions which are quite independent of the grafted vine — good or bad seasons, soil conditions, date of harvest, condition and quantity of produce, etc. It is a character, therefore, due partly to internal (intrinsic) and partly to external (extrinsic) conditions or due to the environment in and conditions under which the vine is cultivated.

2) A high yield is not always proof of an inferior quality produce: on the contrary there is sometimes no connection between quality and quantity in the case of very productive stock planted in fresh and fertile soil.

3) The differences in the alcohol degree of wines due to variations in weather condition from one year to another, are very marked and range from a minimum of 1.3° to a maximum of 3.4°, according to the quality of the stock, but are much less in dry years (1.5°) than in wet years (2.6°).

4) The differences in the alcohol degree, due to variations in soil are less marked than the preceding ones, and range from a minimum of 0.3° to a maximum of 1.3°, according to the stock. The limits within which these variations occur are the same in dry, as in moist soils.

5) Differences due to the nature of the stock are still less marked and do not exceed an average of  $\frac{1}{10}$  of a degree.

6) Such variations in the alcohol degree of one stock or another may be obscured by other components of the wine, so that they are hard to detect by the taste.

7) An average of four years of experiment shows that the various stock may be classed in the following decreasing order with regard to the

quality of the produce :— 420 A, Aramon  $\times$  Rupestris 1202 and 17-37 (both of the same degree) and Rupestris du Lot.

8) The stocks which gave produce of the most constant quality and quantity were 17-37 and 420 A. As a rule these are vines of average yield and vigour, earlier or less sensitive to seasonal influences and various other factors. Aramon  $\times$  Rupestris, Rupestris du Lot, and 1202 gave irregular produce, though with a high alcohol degree, especially the first two.

9) The differences from one year to another, and even in the same year, between the yield of Grillo and that of the native vines grown in the Marsala district, are very marked, even when the plants are grafted on the same stock.

10) The quality of the produce, within certain limits at least, is in inverse ratio to the drought-resistance of the stock, their vigour and the delay in the ripening of the grapes in moist soils or wet years, and vice versa. It improves in proportion to the lateness of the harvest, and is in accordance with the facility with which the vines adapt themselves to very calcareous soil.

What is the practical importance of the variations produced by the scion on the different stocks, and how can they be combined with those produced by environment and other known causes so as to produce the best results? First of all it is possible to obtain with grafted vines wine of excellent quality even surpassing that of the wines obtained in the past; the same applies to yield.

There are many causes accounting for differences in the quality of the produce — larger productive capacity of native vines grafted on American ones, earlier development and riper grapes, more careful selection of the graft cuttings and the native varieties, simultaneous and concordant action of the variations caused by the scion with that of the other factors, or of the compensation between the effects of the scion and those of other causes acting in the opposite sense.

Grafting on American vines is an efficient method of regulating the vegetation and yield of the vines. All depends on a choice of a scion which, without prejudice to the yield and life of the plant, develops best the desired qualities.

On the other hand, however, experience has shown that the yield of no stock is positive, but only relative, according to the year, nature of the soil, etc. Therefore, whereas on one hand preference should be given to certain stock which give a high yield of the best quality fruit, it would on the other hand be well to be able to dispose of several stock to take advantage of the character of each, according to the year. The system of plantations of mixed stock and that of cultivating too many different varieties of native vines which, though they produce well are not to be recommended for quality, is to be condemned. At Marsala such varieties should be limited to Grillo and Cataratto; only in special cases should Catanese and Damaschino be used.

Many Sicilian vine-growers have been too easily led to favour Aramon  $\times$  Rupestris, a stock which certainly has undeniable advantages, amongst

which is the very important one of giving very high yields, but which for various reasons should not form the sole base of reconstitution or the risk of making a serious mistake is incurred. In reconstitution more importance should be given to the Berlandieri hybrids, hitherto little used as compared with Aramon  $\times$  Rupestris, but for which a great future is in store by reason of their characteristic qualities and, above all, the excellent and regular yield obtained from native vines with them. Of these may be specially recommended 420 A, 17-37, 34 E. M and also 41 B, to which may perhaps be added in time other good hybrids obtained in Sicily by PAULSEN, RUGGERI, and GRIMALDI.

Another stock which has given excellent results in the Marsala district is Mourvèdre  $\times$  Rupestris 1202, especially when grafted with Grillo, not only by reason of its luxuriant vegetation, but also because of the high alcohol degree and fineness of the wines made from it.

The system of using a single stock, even in the case of the quality, has been, and always will be, a great mistake, as great, or even greater, than that of mixing many different vines.

From a point of view of wine-making, the authors found that at Marsala, beside the typical liqueur, it would be possible to produce an excellent, almost colourless white wine, alcoholic, but of an acid and slightly tart flavour. This is obtained especially from Grillo grafted on Aramon  $\times$  Rupestris or other late-ripening stock. Such wine would be valuable in the export trade. To make it, apart from the use of the varieties mentioned above, it is only necessary to subject the wine as little as possible to the action of air and heat, which are the two essential factors in the manufacture of Marsala. These conditions may easily be obtained by bottling the new wine when a few months old, after decanting it with a pump to avoid contact with the air, closing the bottles hermetically and keeping them in a coldish cellar. If this is not done, in time the wine changes colour and flavour, acquiring the characters of Marsala without any special process.

#### LIVE STOCK AND BREEDING.

875 - Observations on Abortion Disease, in the United States. — SCHROEDER, E. C. and CORSON, W. E. (Bethesda, Md., Experiment Station, Bureau of Animal Industry, U. S. Department of Agriculture), in *The Journal of Agricultural Research*, Vol. XI, No. 1, pp. 9-16. Washington, April 2, 1917.

As far as the writers have been able to learn in their wide experience with the disease, the abortion bacillus is an obligatory parasite. It may live and retain its virulence for a long time in infected material expelled from the uteri of infected cows, but no data are available to support the belief that it can maintain itself or multiply under natural conditions as a saprophyte. Hence, the chronic persistence of the microparasite in the bodies of infected cows is probably the most important among the causes responsible for the propagation, the perpetuation, and wide prevalence of the disease.

[874-875]

The favourite habitat of the abortion bacillus in the bodies of cows is the udder, and the udder is seemingly its only habitat in the bodies of non-pregnant cows. One cow under test for 7 years gave abortion bacilli continuously in her milk. The bacillus was never found in the milk from a cow unless both her milk and her blood serum possessed agglutinating properties for it, but repeatedly cows were found which reacted, but the bacilli were not found in the milk. By experimental inoculation of a cow, the authors were able to demonstrate that the bacilli passed from the udder to the uterus. They believe that the abortion bacilli in ingested milk do not penetrate deeply or abundantly into a calf's body.

876 • **Contribution to the Study of the Mortality of Calves: Coli-bacillary Broncho-pneumonia.** — COMINOTTI, L. (Stazione sperimentale per le Malattie infettive del bestiame in Milano), in *La Clinica veterinaria*, Year LXXI, No. 7, pp. 167-173, Milan, April 15, 1918.

Under the general term of mortality ("moria") of calves various morbid forms are included that are classified differently by various authors. The predominating form is, however, coli-bacillosis, though it appears under different clinical, anatomical and pathological aspects. The appended observations were made by the author during protracted researches.

Coli-bacillosis of calves may develop under the clinical, anatomical and pathological form of an acute broncho-pneumonia.

The articular form of coli-bacillosis may, in certain cases, represent a complication of the septicæmic form of uncertain course, owing to a secondary infection by common organisms.

*Bacterium coli* may cause nodular formations in the liver of calves, as was observed by LANGER for a bacillus of the sub-group *Enteritidis Paratifo* B., and by VALLÉE in pseudo-tuberculosis of calves.

877 • **Method for Freeing Pigs from Lice.** — CHAGAS e QUINTEAS, Vol. XVII, No. 1, pp. 15-15 + 2 Figs. São Paulo, January 15, 1918.

The following mixture is recommended for destroying lice and all ecto-parasites of pigs: oil (any quality) 1.75 pints; paraffin 0.88 pints; essence of turpentine 0.44 pints; about 2 gallons of hot water. This preparation should be applied twice at an interval of ten days. When breeding on a large scale baths should be constructed, or it may be applied by the pigs themselves by means of special apparatus (one is sufficient for 250 animals) consisting of a support firmly fixed into the ground against which the animals rub themselves, surmounted by a vessel containing the mixture and fitted with valves which open when the support is slightly raised by the pigs rubbing themselves. The sties must also be disinfected.

878 • **On the Hereditary Transmission of Rabies** (1) — I. LANFRANCHI, A. and LENZI, F. Transmission of the Virus of Rabies from Mother to Fœtus, *Comptes rendus des Séances de la Société de Biologie*, Vol. LXXXI, No. 8, pp. 396-398, Paris, April 28, 1918. — II. REMLINGER, P., On the Possibility of Conceptual Rabies, *Ibid.*, pp. 418-419.

I. — The authors record a new case of the transmission of the virus of rabies from mother to fœtus, observed in a bitch which had lived for some

(1) See R., April 1916, No. 413. (Ed.)



time in contact with a mad dog, 6 months before conception. At the post-mortem, NEGRI corpuscles were found in the region of the cornu of the brain; the biological test (injection of dilute marrow in rabbits) gave positive results. This proves that the virus of rabies in the blood-stream can pass the placental filter and infect the fœtus.

II. — The possibility of conceptional rabies presupposes the presence of the virus of rabies in both the sperm and ovule. For this reason the author sought for it in the contents of the seminal vesicles, in the testicles, and in the ovaries of rabid guinea-pigs. The results were always negative. The author concludes that conceptional rabies does not exist and that all the cases of inherited rabies are to be traced back to placental infection.

879 — **Studies on Sarcoma in Chickens.** — JABLONS, B., in *Comptes rendus des Séances de la Société de Biologie*, Vol. LXXXI, No. 7, pp. 327-328. Paris, April 13, 1918.

The author first studies the spread of sarcoma virus through the chicken's organism. The virus enters the blood. The serum of an infected chicken (prepared either by coagulation or by centrifugalisation of freshly drawn blood) injected into a new chicken in amounts of 1 cc. reproduces sarcoma with the characteristic fusiform cells. If the chicken shows general sarcomatosis of the peritoneum the virus passes into the ascitic liquid.

The increase in the virulence of the serum of infected chickens kept 10 days in the incubator at 37° C. was then studied. Under these conditions the serum was four times as virulent and reproduced lesions in a fresh chicken when injected in quantities of 0.25 cc. The author does not believe this to be a case of true increase in virulence, but rather of an increased number of micro-organisms which have multiplied at the temperature of the incubation. The passage of the virus through the chicken increases its virulence and shortens the incubation period of the disease (after the 7th. passage of the virus the lesions developed in 13 days instead of 27 to 42).

The fleshy tumour dried and kept in the ice-chest, retained its virulence for twelve months, but lost it at the end of the thirteenth.

880 — **Mallophaga Ectoparasitic on Birds, in Formosa.** — UCHIDA, SEINOSUKE, in the *Journal of the College of Agriculture, Imperial University of Tokyo*, Vol. III, No. 4, pp. 171-188 + 1 Plate. Tokio, June 15, 1917.

The author describes 21 species (17 being new to science) belonging to 8 genera of Mallophaga ectoparasitic on birds killed in Formosa. These are: — *Laemobothrium loomisii* on *Nannocnus cinnamomea*; *Lipeurus variabilis* and *Nirmus vittatus* on *Accipiter virgatus*; *Colpocephalum osborni* on *Milvus ater* *govinda*; *Colpocephalum pachyaster* on *Pandion haliaetus*; *Nirmus ovatus* n. sp., *Lipeurus variabilis*, *L. intermedius* var. *major* n. var., *Goniodes intermedius*, *Menopon productum*, *M. mikadokiji* n. sp., on *Calophaps mikado*; *Lipeurus formosanus* n. sp., *L. rubrifasciatus*, *Goniocotes microcephalus* n. sp., *Menopon pallescens*, *M. longipectum* n. sp. on *Arboricola crudigularis*; *Colpocephalum umbrinum* var. *trilobatum* on *Tringa subminuta*; *Nirmus incanensis* on *Tringa ruficollis*; *Lipeurus baculus* on

*Turtur chinensis*; *Lipeurus baculus* and *Goniocotes kurodai* n. sp. on *Spenocercus sororius*; *Docophorus communis* on *Pericrocotus griseigularis*; *Lipeurus baculus* and *Goniocotes kurodai* on *Grancalvus rex-pineti*; *Menopon urocissae* n. sp. on *Urocissa caerulea*.

881 - **A Study of the Dietary Essential, Water-Soluble B, in Relation to its Solubility and Stability towards Reagents.** — MCCOLLUM, E. V. and SIMMONDS, N. (Laboratory of Agricultural Chemistry of the University of Wisconsin, Madison), in *The Journal of Biological Chemistry*, Vol. XXXIII, No. 1, pp. 55-89, 11 Diagr., Bibliography of 15 Publications. Baltimore, Md., January, 1918.

In conducting the work reported in this paper the authors fed rats on a diet of purified food substances together with 5 per cent of butter fat to supply an abundance of the fat-soluble A. This diet was complete except that it was free from the water-soluble B. The rats were confined to this food mixture until they either had become stationary in weight or were declining. By the 5th week nearly all were either stationary in weight or were failing and they almost invariably showed signs of paralysis at about this time. When the rats were thus prepared, the material to be tested for the water-soluble B was put into the diet. The animals then either continued to decline or responded with growth. This method served to show within 2 weeks whether the substance B was contained in significant amount in the preparation under investigation.

In the experimental part of this paper it is shown that the water-soluble B is not extracted directly from beans, wheat germ, or pig kidney by ether, benzene, or acetone, but it is readily extracted in great part by alcohol. After being removed by alcohol it is shown to be soluble in benzene, but very slightly soluble in acetone. The probability that there should be two or more physiologically indispensable substances in what is termed water-soluble B, both or all of which should show the same solubility relations with three solvents, is relatively small and lends support to the authors' view that the substance which protects animals against polyneuritis is the only essential complex in the extract described. In other words, the data support the view that there are no specific substances present in these extracts which protect against such diseases as scurvy, rickets, pellagra, sprue, etc., and tend to confirm the contention that the latter are not due to specific starvation as in the case with beri-beri and xerophthalmia (1).

882 - **A Comparative Study of the Behaviour of Purified Proteins towards Proteolytic Enzymes.** — FRANKEL, E. M. (Sheffield Laboratory of Physiological Chemistry, Yale University, New Haven), in *The Journal of Biological Chemistry*, Vol. XXVI, No. 1, pp. 31-59 + 9 Tables + 4 Diagrams + Bibliography of 33 Publications. Baltimore, Md., August, 1916.

After having rapidly considered the methods — physico-chemical, optical, colorimetric, purely chemical — used up to the present for studying the processes of digestion, the author describes his experiments for the pur-

(1) See *R.* January 1918, No. 2. (Ed.)

pose of studying the digestibility of the white of egg by means of pepsin, trypsin and erepsin; the results obtained by the author are given below.

It has been demonstrated that pepsin is the effective agent in pepsin-hydrochloric acid digestion, since hydrochloric acid alone in the concentrations ordinarily employed has very little proteolytic effect. As a result of a series of experiments the conclusion seems justified that comparable results in proteolysis studies are to be obtained only when the substrates are in solution; otherwise deviations of 10 to 15 per cent may be encountered in duplicate experiments. An examination of the digestion of thirteen proteins shows that there is a parallelism in the cleavage curves of all the proteins, if the cleavage is calculated as the ratio of the amino-nitrogen liberated at any one time to that obtained on total hydrolysis of the protein with strong acid.

Pepsin-hydrochloric acid can liberate about 20 per cent. of the total amino-nitrogen of a protein in less than 100 hours. Trypsin acting upon proteins partially digested with pepsin effects a cleavage of about 70 per cent. The action of trypsin upon native proteins can cause a cleavage of about 50 per cent of the peptide linkages. Further addition of trypsin may cause further disintegration of the protein.

Erepsin following the action of pepsin is a very effective agent in causing the disruption of the protein molecule. In two series of experiments cleavage of about 85 per cent of the protein could be demonstrated. The successive action of pepsin, trypsin, and erepsin liberates about 85 to 90 per cent of the total amino-nitrogen of the protein studied.

**883 - Study of the Proteins of Certain Insects with Reference to their Value as Food for Poultry.**—McHARGUE, J. S. (Laboratory of Chemical Research, Kentucky Agricultural Experiment Station), in the *Journal of Agricultural Research*, Vol. X, No. 12, pp. 633-637 + Bibliography of 9 Publications. Washington, September 17, 1917.

THOMAS was the first to demonstrate experimentally that animal proteins are much superior to vegetable proteins in maintaining the nitrogen equilibrium of the animal body. He showed that the minimum daily quantities necessary to protect body protein from loss were: — meat protein 30 gm., milk protein 31 gm., rice protein 34 gm., potato protein 38 gm., bean protein 54 gm., bread protein 76 gm., maize protein 102 gm.

The author determined the percentage of growth-promoting acids in the proteins of two common insects — the June bug (*Lachnosterna* sp.) and the grasshopper (*Melanoplus* spp.) as compared with the percentage of proteins in roast beef and turkey white meat. He found the following values for each of the two insects respectively: — Ammoniacal nitrogen, 8.96, 9.14; melanin, 6.78, 3.42; arginin, 11.53, 14.98; histidin, 6.57, 5.62; cystin, 0.35, 0.23; lysin, 8.02, 8.04; amino nitrogen (in filtrate from bases), 50.80, 52.87; non-amino nitrogen (in filtrate from bases), 5.84, 4.32. There is, on the whole, a great similarity in the proteins from such different sources. There is a close agreement in the lysin and arginin contents of the two insects studied and beef and turkey meat. In the beef and turkey the percentage of cystin is almost double and that of histidin two to three times that of the insects.

The protein content of grasshoppers, killed by potassium cyanide, dried at 100° C., ground in a mortar, and kept in a closed bottle for seven months, underwent no alteration, thus showing that the dried material can be kept indefinitely. An analysis of the dried matter gave the following percentages: — Protein, 75.28; ether extract, 7.21; crude ash, 5.61. Dried grasshoppers contain more protein than commercial meat meal and would probably be an excellent substitute for it in poultry feeding.

884 — **Utilization of Farm Wastes in Feeding Live Stock in U. S. A.** — RAY, S. H., in *U. S. Department of Agriculture, Farmers' Bulletin 873*, pp. 1-12. Washington, D. C., April, 1917.

More than  $\frac{1}{3}$  of the total production of cereal straw in the United States is not used to advantage, and  $\frac{1}{2}$  of this amount is a total loss, the value of which is estimated at more than \$100 000 000. In a three years' study of corn-belt cattle the Office of Farm Management found that the breeding herds maintained most largely on oat or wheat straw, maize stover, etc. (with a very small quantity of concentrated feed such as cottonseed meal, maize, etc.), returned the largest profits.

Of all the uses to which straw and maize stover may be put, the only really economical ones are as food or bedding, and, of these two, their use as food is by far the most satisfactory.

To prepare stover for feeding purposes it should be cut and shocked; it may be chopped or shredded if cheap power and labour are available, but otherwise the cost is disproportionate to the advantages gained. Waste is greatly decreased by shredding or cutting dry corn stover and putting it in the silo with water. Of all the methods, ensiling is the most economical. Straw and stover should be used in the fattening rations of all animals except hogs, and should compose the larger part of all winter or maintenance rations for cattle, sheep and horses. Breeding herds of beef cattle, and dairy cows do well on rations composed largely of these products; the same applies to ewes if some grain is added. Horses doing very light work or none at all need little grain if they have a liberal allowance of clean straw or stover. Rye straw should not be fed to dairy cattle, because of its toughness and the danger from ergot, and buckwheat straw, on account of its low food value, should only be given when other roughages are not available. When barley straw is used the mouths of the cattle should be examined occasionally as the dry, stiff beards are apt to set up irritation.

The following rations are proposed for various classes of animals: —

**BEEF CATTLE. Winter rations. —**

- 1) Straw, 10 lb.; silage, 20 lb.; cottonseed or linseed meal, 1 lb.
- 2) Straw, 20 lb.; cottonseed or oil cake, 2 lb.
- 3) Straw, 10 lb.; maize fodder, 10 lb.; cottonseed or linseed meal, 1 lb.
- 4) Stover, 35 lb.; cottonseed or linseed oil meal, 1 lb.

**Fattening rations (for 1 000 lb. steers). —**

- 1) Straw, 5 lb.; silage, 18 lb.; maize, 12 lb.
- 2) Straw, 8 lb.; leguminous hay, 6 lb.; cottonseed or linseed cake, 5 lb.
- 3) Stover, 10 lb.; silage, 15 lb.; maize, 12 lb.
- 4) Straw, 5 lb.; stover, 15 lb.; maize, 6 lb.; cottonseed meal, 3 lbs.

**DAIRY CATTLE. Ration for dry cows, bulls and heifers. —**

Maize stover and straw, unlimited; clover hay, 10 lb.; maize silage, 20 lb.; cottonseed meal, 1 lb.; maize- and-cob meal, 2 lb.

**Ration for cows about to calve. —**

Maize stover, 5 lb.; clover hay, 12 lb.; maize silage, 25 lb.; wheat bran, 3 lb.

**Ration for cow giving 16 lb. of 4 % milk. —**

Maize stover and straw, unlimited; clover hay, 12 lb.; maize silage, 20 lb.; cottonseed meal, 2 lb.; maize-and-cob meal, 3 lb.

**Ration for cow giving from 20 to 25 lb. of 4 % milk. —**

Maize stover and straw, unlimited; clover hay, 12 lb.; maize silage, 25 lb.; cottonseed meal, 2 lb.; maize and cob meal, 3 lb.; gluten feed, 3 lb.

**SHEEP. (Supplementary rations with a little grain). —**

1) Maize stover, 2 lb. (amount eaten, not amount fed); leguminous hay, 2 lb.

2) Oat straw, 2 lb.; leguminous hay, 2 lb.;

3) Oat straw or maize stover, 1 lb.; silage, 1 1/2 lb.; leguminous hay, 2 lb.

**HORSES. Maintenance rations for 1000 lb. idle horse. —**

1) Maize stover, 9 lb.; alfalfa hay, 3 lb.; maize on cob, 5 lb.

2) Oat straw, 8 lb.; alfalfa, 6 lb.; cane molasses, 3 lb.

**Daily ration for 1000 lb. horse at light work. —**

1) Maize stover, 5 lb.; Bermuda hay, 5 lb.; cottonseed meal, 1/2 lb.; cowpeas, 2 lb.; shelled maize, 5 lb.

**Daily ration for 1000 lb. horse at heavy work. —**

Maize fodder, 4 lb.; alfalfa, 12 lb.; ground soy beans, 1 lb.; shelled maize, 12 lb.

**Daily rations for 1250 lb. idle horse. —**

1) Maize stover, 11 lb.; alfalfa, 5 lb.; ear maize, 4 lb.

2) Oat straw, 10 lb.; pea hay, 4 lb.; common beets (or other roots or silage), 4 lb.; oats, 4 lb.

**Daily ration for 1250 lb. horse at light work. —**

Barley straw, 5 lb.; alfalfa hay, 6 lb.; rolled barley, 8 lb.

**Daily ration for 1500 lb. idle horse. —**

Maize fodder (with ears), 18 lb.; alfalfa, 5 lb.

**885 - Observations on the Inheritance of Colour and Distribution of Sex in Certain Animals at the Government Cattle Farm, Hissar, Punjab, India. —** BRANFORD, R. (Superintendent, Government Cattle Farm, Hissar), in *The Agricultural Journal of India*, Vol. XII, Pt. IV, pp. 573-578. Calcutta, October, 1917.

**INHERITANCE OF COLOUR IN MULES. —** Several years of breeding gave the following results:

Number and colour of mares	Colour of donkey	Number and colour of mules
12 { bay or brown	black or dark brown	111 bay or brown
12 { bay or brown	mouse-colour,	6 bay or brown.
13 chestnut	black or dark brown	41 bay or brown
1 chestnut	mouse-colour	1 bay
13 roans	black or dark brown	18 bay or brown; 2 dun
14 grey	black or dark brown	18 bay or brown; 6 grey; 2 dun; 1 mouse-colour.
6 grey	mouse-colour	6 bay or brown.
4 dun	black or dark brown	4 bay or brown.
1 dun	mouse-colour	1 bay
2 skewbald	black or dark brown,	3 bay or brown.

It is seen, therefore, that by crossing brown or mouse-coloured donkeys with brown or chestnut mares bay or brown mules, are sure to be obtained. The army prefers dark mules. Chestnut colour, which is recessive in mares and does not exist in donkeys, is rarely found in mules though it does occur. Of 1200 mules entered in the register of the Government Cattle Farm, Hissar, 8 were chestnut. Similarly, by crossing dun, roan or skewbald mares with dark donkeys, bay or brown mules are nearly always obtained. Uniform colour in donkeys seems dominant to white spots on the head and legs in mares, as mules practically never have these spots.

From two chestnut mares and one skewbald mare served by a zebra were obtained three hybrids with coats having a light bay, rather yellow ground, and the distinctive black markings of the zebra.

#### INHERITANCE OF COLOUR AND DISTRIBUTION OF SEX IN DONKEYS.

-- The following data are compiled from the Government Cattle Farm, Hissar register. It is pointed out that mistakes may easily be made in describing a donkey as grey; this largely discounts the value of the figures:—

Number and colour of mares	Colour of stallion	Number and colour of foals
16 brown	black or dark brown	82 brown; 8 grey; 3 mouse-colour.
4 brown	mouse-colour	2 mouse-colour; 1 grey; 1 brown.
9 mouse-colour	black or dark brown	14 mouse-colour; 17 brown; 6 grey;
1 mouse-colour	mouse-colour	1 mouse-colour.
4 white	black or dark brown	12 grey; 1 brown; 6 mouse-colour
13 grey	black or dark brown	26 brown; 5 mouse-colour, 27 grey.

It seems that, as a rule, black or dark brown donkeys transmit this colour to their progeny. The striking tendency of the coats of grey horses and mules to turn lighter with age is not observed in donkeys, whose coats tend to become darker. During the last 10 years 530 donkeys, of which 272 were colts and 258 fillies, were born at the Government Cattle Farm, Hissar.

**INHERITANCE OF COLOUR IN SHEEP.** — Seven lambs of five black ewes served by an Australian white Merino ram were all black.

**INHERITANCE OF COLOUR AND DISTRIBUTION OF SEX IN CATTLE.** — Red Sihwal cows bred to a red bull of the same race gave 48 red calves and 2 grey ones. Sihwal cattle may be of various colours, but red is usually preferred. During the last 10 years there were born on the Hissar Government Farm 7642 calves, of which 3927 were male and 3715 female.

586 — **Oatless Rations for Draught Horses.** — DECHAMPRE, M. P., in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 15, pp. 480-497. Paris, May 1, 1918.

This is a paper presented to the "Académie d'Agriculture", indicating the substitutes which may be advantageously used at the present time in the feeding of draught horses, and giving formulæ for mixing them so as to obtain a food value equal to that of oats, as well as complementary rations containing rough and concentrated foodstuffs.

The food value of a substitute is based on the amount required to replace 1 lb. of oats. The proportion, however, is not constantly exact; to

obtain a good ration of substitutes the foodstuffs must be judiciously mixed in order to obtain the essential result; *i. e.*, to give the animal amounts of food equal to its original ration without modifying perceptibly the volume and bulk of the ration or the equilibrium established by determining its nutritive ratios.

*Equivalency in oats of the principal substitutes (weight in lbs. equal to 1 lb. of oats):*

Groundnut cake . . . . .	0.743	Molasses straw (25 % saccharose) . .	1
Locust bean . . . . .	1	Palm kernel cake . . . . .	0.849
Copra cake . . . . .	0.800	Paddy . . . . .	1
Dried brewer's grains . . . . .	1.100	Sesame cake . . . . .	0.765
Barley germ . . . . .	0.900	Soya cake . . . . .	0.728
Cottonseed cake . . . . .	0.800	Soya meal . . . . .	0.730
Nut cake . . . . .	0.750		

*Formulae for mixing concentrated foods capable of replacing oats (in lbs.).*

- 1) Groundnut cake 1, cottonseed cake 0.500, barley germ 1, molasses straw 1.500.
- 2) Palm kernel cake 1, soya cake 0.500, bran 1.
- 3) Dried brewer's grains 1.500, rice residue 0.750, groundnut cake 0.500, copra cake 0.500.
- 4) Groundnut cake 2, bran 2, molasses straw 2.
- 5) Rice residue 2, groundnut cake 0.400, meat meal 0.150.

One pound of each of these mixtures will replace 1 lb. of oats; the final ration should be completed with hay and straw.

The following simpler mixtures are intended for partial substitution by available materials; each has the same food and energy value as 1 lb. of oats:

- 1) Equal weights of dried brewer's grains, rice residue, wheat bran, cottonseed or copra cake.
- 2) Equal weights of wheat bran, dried brewer's grain, groundnut meal.
- 3) Equal weights of sorghum or barley bran, dried brewer's grains, soya meal.
- 4) Wheat bran 0.900 lb., rice residue 0.600 lb.
- 5) Rice bran 0.750, groundnut cake 0.150;
- 6) Barley roots 0.700, bran 0.400; mixture recommended for the preparation of mash.

These formulae may be varied in numerous ways. Chopping hay and straw makes possible other combinations of which the following two are samples: —

- 1) Groundnut cake 15 lb., cottonseed cake 5, bran 20, molasses 20, chopped straw 25, chopped hay 20; 1.1 lb. of this mixture equal 1 lb. of oats.
- 2) Cake (groundnut, sesame) 1 lb., soya meal 5, cottonseed cake 2, bran 18, molasses 20, chopped straw 25, hay 20; 0.68 lb. equal 1 lb. of oats.

Other foodstuffs — sorghum and buckwheat brans (which contain four times more cellulose than ordinary bran), sainfoin seed unsuitable for germination (food value similar to that of oats; should be used in small

quantities, in the natural state and mixed with oats or after soaking), beet feed is also unsuitable for sowing (value = about  $\frac{2}{3}$  that of wheat bran.)

*Aqueous foodstuffs.* — Tubers and roots may be used in feeding horses to a larger extent than is customary, thus allowing a reduction in the quantity of oats. The amount to be substituted cannot be calculated with much precision as for the preceding foods because of the difference in chemical composition and especially in the volume and water content of this produce.

*Carrots.* — 1 lb. of oats, 1 lb. of hay, 1 lb. of straw may be replaced by 1 lb., 3 lb., and 2 lb. of carrots respectively. The usual carrot ration is 2 lb. for a horse of the average weight of 1 000 lb.

*Parsnip.* — Preferred to carrot in Brittany; same proportion for substitution.

*Beet.* — As much as 22 to 26 lb. may safely be given to horses used for field work

*Jerusalem artichoke.* — A ration of 22 to 26 lb. may be safely fed; 3.5 lb. equal 6 lb. of carrots. A heavy draught horse (to which this foodstuff is better suited than to a carriage horse) can consume 13.2 lb. of Jerusalem artichoke, thereby replacing 3.3 lb. of oats or similar produce.

*Boiled potatoes.* — An amount equal to 0.9 lb. of dry matter is equal to 1 lb. of oats; thus, 3.60 lb. of average quality potatoes containing 25 % of dry matter can replace 1 lb. of oats. The ordinary ration is 11 lb. as a substitute for 2.97 lb. of oats.

All these substitutes should be worked on to gradually, beginning with small quantities; this is essential to avoid refusal to eat them and consequent waste.

Horses may be profitably put to grass and fed on alfalfa and green clover to economise maintenance expenses, but they must be put on oats again as soon as they re-start heavy work. The amount of green fodder which can be fed daily to a horse of 1 000 to 1 300 lb. without danger of digestive trouble, varies from 88 to 110 lb. according to the nature of the soil and the forage.

387- **Winter Steer Feeding Experiments in Indiana, U. S. A.** (1). — SKINNER, J. H. and KING, F. G., in *Purdue University Agricultural Experiment Station Bulletin No. 206*, Vol. XX, pp. 1-28. Lafayette, Indiana, September, 1917.

The cattle feeding trials reported in this bulletin were conducted under exceptional economic conditions. The object of the trial was to obtain additional information on the comparative value of leguminous hay alone and in combination with maize silage as roughage for fattening cattle, to test the comparative value of clover hay and alfalfa hay as roughage for full-fed cattle, and to test the value of different rations with a limited feed of maize with maize silage as compared with a full feed of maize for finishing steers.

*Plan of experiments.* — Seventy medium feeding cattle were secured

(1) For similar experiments conducted under normal conditions see also R. June 1918, No. 668. (Ed.)



and divided into seven lots of ten steers each, as nearly alike as possible in size, condition, quality, thrift and breeding.

Each lot of cattle was placed in similar surroundings and fed for 140 days. The only differences between lots were in the rations fed which were as follows:—

*Lot 1.* No maize during the first month and a gradually increasing amount of shelled maize for the remainder of the period, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, maize silage, clover hay throughout entire period.

*Lot 2.* Shelled maize, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, clover hay.

*Lot 3.* Shelled maize, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, alfalfa hay.

*Lot 4.* Shelled maize, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, maize silage, clover hay.

*Lot 5.* No maize, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, maize silage, clover hay.

*Lot 6.* One-half feed maize, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, maize silage, clover hay.

*Lot 7.* Shelled maize, cottonseed meal 2.5 lb. daily per 1 000 lb. live weight, maize silage, alfalfa hay.

The prices of feeds used in presenting financial results are based on the actual market prices at the time the experiment was in progress. The average price of maize in La Fayette was as follows:—first month 88.3 *cents*, second month 93.9 *cents*, third month \$ 1.007, fourth month \$ 1.138, fifth month \$ 1.431 per bushel, cottonseed meal \$ 45.00 per ton, clover hay and alfalfa hay \$ 12.00 per ton, maize silage \$ 6.00 per ton. All financial statements are based on the above mentioned prices of feeds.

Each lot of cattle also contained ten hogs. They were of good quality and averaged approximately 105 lb. per head at the time the experiment started. All lots of hogs received maize in addition to droppings from the cattle. Table I shows a summary of the feeding operations and their results as relating to the 7 lots, comparing:—in lots 2, 4, 3, 7 (Part I, maize silage and leguminous hay vs. leguminous hay as roughage; in lots 4, 1, 6, 5 (Part II), a limited feed of maize with a full feed of maize; in lots 2, 3, 4, 7 (Part III), clover vs. alfalfa hay as roughage.

In the determination of costs no charge was made for straw used for bedding nor for labour of feeding; neither is any credit given for any manure produced by the cattle, it being considered that this by-product will pay for the labour of feeding and the straw used for bedding.

The principal results of these experiments may be summarized, as follows:—

*Part I.* (Maize silage and leguminous hay vs. leguminous hay as roughage for fattening steers; Lots 2, 4, 3 and 7).

The addition of 33.88 lb. of maize silage to a ration of shelled maize, cottonseed meal and clover hay, decreased the daily maize consumption 2.79 lb. per head and the daily hay consumption 11.46 lb. per steer.

## Summary of Experiments.

Part I, II, III.

Ration	Lot 1	Lot 2	Lot 3 (2)	Lot 4	Lot 5	Lot 6	Lot 7
	Shelled maize (1), cottonseed meal, maize silage, clover hay	Shelled maize, cottonseed meal, clover hay	Shelled maize, cottonseed meal, alfalfa hay	Shelled maize, cottonseed meal, maize silage, clover hay	No maize, cottonseed meal, maize silage, clover hay	One-half feed maize, cottonseed meal, maize silage, clover hay	Shelled maize, cottonseed meal, maize silage, alfalfa hay
Initial value per 100 lb. . . . . \$	8.15	8.15	8.15 *	8.15	8.15	8.15	8.15
Initial weight. . . . . lb.	10 472	10 408	9 513	10 443	10 452	10 448	10 442
Final weight . . . . . "	13 143	13 637	12 235	13 943	12 727	12 713	13 258
Total gain . . . . . "	2 671	3 229	2 722	3 500	2 275	2 265	2 816
Average daily gain . . . . . "	1.91	2.31	2.16	2.50	1.63	1.62	2.01
Total feed consumed:							
shelled maize. . . . . "	8 500	24 455	20 350	18 555	—	9 480	18 325
cottonseed meal. . . . . "	4 059	4 059	3 693	4 184	4 014	3 999	4 049
maize silage. . . . . "	61 635	—	—	47 425	74 495	59 710	47 891
clover hay . . . . . "	5 615	18 900	—	2 860	4 076	3 830	—
alfalfa hay . . . . . "	—	—	18 394	—	—	—	2 237
Daily feed per steer:							
shelled maize. . . . . "	6.07	16.04	16.15	13.25	—	6.77	13.09
cottonseed meal. . . . . "	2.90	2.90	2.93	2.99	2.87	2.86	2.89
maize silage . . . . . "	44.03	—	—	33.88	53.21	42.65	34.21
clover hay . . . . . "	4.01	13.50	—	2.04	2.91	2.74	—
alfalfa hay . . . . . "	—	—	14.60	—	—	—	1.60
Cost of gain per 100 lb. . . . . \$	17.51	19.99	21.77	17.51	14.87	20.97	21.36
Necessary selling price . . . . . "	10.50	10.95	11.18	10.50	9.36	10.43	10.96
Actual selling price in lots without shrink . . . . . "	12.00	11.75	11.75	12.00	10.75	10.85	12.00
Profit per steer not including pork "	20.93	10.85	7.74	20.93	17.80	5.30	13.84
Pork produced. . . . . lb.	1 275	1 479	1 586	1 275	748	1 035	990
Maize fed to hogs. . . . . "	1 996	2 594	2 594	1 996	4 324	3 374	1 959
Shorts fed to hogs. . . . . "	210	210	210	210	—	—	—
Tankage fed to hogs . . . . . "	210	210	210	210	—	—	—
Profit per steer including pork . . . \$	35.65	27.60	28.20	35.65	21.21	14.95	25.48

(1) Fed limited grain ration.

(2) Nine steers in Lot 3.

The addition of 34.21 lb. of maize silage to a ration of shelled maize, cottonseed meal and alfalfa hay, decreased the daily maize consumption 3.06 lb. per head and the daily hay consumption 13.00 lb. per steer.

The addition of maize silage to a ration of shelled maize, cottonseed

[987]

meal and clover hay, increased the rate of gain 0.19 lb. daily per steer. The addition of maize silage to a ration of shelled maize, cottonseed meal and alfalfa hay, decreased the rate of gain 0.15 lb. daily per head.

The addition of maize silage to the ration, decreased the cost of gain \$ 2.48 per hundred pounds when clover hay was fed and 41 cents per hundred pounds when alfalfa hay comprised a part of the ration.

Maize silage in the ration increased the selling value of the cattle 25 cents per 100 lb.

The profit per steer not including pork was increased \$ 10.08 per steer by adding maize silage to a ration of shelled maize, cottonseed meal and clover hay; the profit per steer not including pork was increased \$ 6.10 by the addition of maize silage to a ration of shelled maize, cottonseed meal and alfalfa hay.

*Part II.* (A limited feed of maize as compared with a full feed of maize for fattening steers. Lots 4, 1, 6 and 5).

The elimination of maize from the ration of shelled maize, cottonseed meal, maize silage and clover hay induced the cattle to increase the roughage consumption 19.33 lb. of maize silage and 0.87 lb. of hay daily per head.

The elimination of one-half the maize in the ration of shelled maize, cottonseed meal, maize silage and clover hay induced the cattle to increase the roughage consumption 8.77 lb. of maize silage and 0.7 lb. of hay daily per head. Feeding no maize during the first month and afterwards a gradually increasing amount until the fifth month, when it amounted to 11 lb. daily per head, induced the cattle to increase the consumption of roughage 10.15 lb. of maize silage and 1.07 lb. of hay daily per head. Cattle receiving a full feed of shelled maize in addition to cottonseed meal, maize silage and clover hay, gained 2.50 lb. daily per head at a cost of \$ 17.51 per 100 lb. gain. Cattle receiving no maize in addition to cottonseed meal, maize silage and clover hay, gained 1.63 lb. daily per head at a cost of \$ 14.87 per 100 lb. gain. Cattle receiving one-half feed of shelled maize in addition to cottonseed meal, maize silage and clover hay, gained 1.62 lb. daily per head at a cost of \$ 20.97 per 100 lb. Cattle receiving a gradually increasing amount of maize in addition to cottonseed meal, maize silage and clover hay gained 1.91 lb. daily per head at a cost of \$ 18.12 per 100 lb.

*Part III* (Clover hay vs. alfalfa hay as roughage for fattening steers; Lots 2, 3, 4 and 7).

Cattle fed a ration of shelled maize, cottonseed meal and clover hay consumed slightly less maize and considerably less hay than cattle fed alfalfa hay instead of clover hay.

Cattle fed a ration of shelled maize, cottonseed meal, maize silage and clover hay consumed slightly more grain and hay but less silage than cattle receiving a similar ration with alfalfa hay replacing the clover hay.

Cattle fed hay in addition to shelled maize and cottonseed meal, gained 2.31 lb. daily per head when clover hay was fed and 2.16 lb. daily per head when alfalfa hay was fed.

Cattle fed clover and alfalfa hay in addition to shelled maize, cotton-

seed meal and maize silage gained 2.5 lb. daily per head when the hay was clover and 2.01 lb. daily per head when it was alfalfa.

Gains on cattle were made at a cost of \$ 19.99 per 100 lb. when the roughage was clover hay and \$ 21.77 per 100 lb. when it was alfalfa hay; at a cost of \$ 17.51 per 100 lb. when the roughage fed consisted of maize silage and clover hay as compared to a cost of \$ 21.36 per 100 lb. when the roughage consisted of maize silage and alfalfa hay.

Cattle fed a ration of shelled maize, cottonseed meal and clover hay, were valued at \$ 11.75 per 100 lb. and returned a profit not including pork of \$ 10.85 per head, as compared to a value of \$ 11.75 per 100 lb. and a profit of \$ 7.74 per head when clover hay was replaced by alfalfa hay.

With maize silage added to the same ration, cattle were valued \$ 12.00 per 100 lb. and returned a profit not including pork of \$ 20.93 as compared with \$ 13.84 per head when clover hay was replaced by alfalfa hay.

888 - **The Relation of the Quality of Proteins to Milk Production.** — HART, E. B. and HUMPHREY, G. C. : I. with the cooperation of SCHAEF, A. A. II. with the cooperation of SCRE. BARNETT (Department of Agricultural Chemistry and Animal Husbandry of the University of Wisconsin, Madison), in *The Journal of Biological Chemistry*, Vol. XXVI, No. 2, p. 457-471 + 4 Diagr. September, 1916; Vol. XXXI, No. 2, pp. 445-460 + 7 Diagr. August, 1917, Baltimore, Md.

I. — In 1915 the authors presented data showing marked inequality in the efficiency of the protein mixture of rations for milk production (1). These further studies furnish additional evidence that the nutritive ratio or plane of protein intake for milk production may vary according to the nature of the concentrates and basal ration used.

Data are presented on the comparative value for milk production of the proteins of gluten feed, oil meal, distiller's grains, casein, and skim milk powder. These concentrates furnished 50 per cent of the total digestible protein of the ration and were used to supplement a basal ration of maize stover, maize silage, and maize meal. The total protein intake constituted about 10 per cent of the dry matter of the ration and the nutritive ratio was approximately 1 : 8.

With a daily production of 40 to 45 lb. of milk carrying 10 to 12 per cent of total solids, negative nitrogen balance persisted throughout the experiment of 16 weeks' duration. Only during the period of skim milk powder feeding was one of the animals storing nitrogen. In spite of this long negative balance milk secretion continued at the expense of catabolizing tissue. The total yields and total solids of the milk declined slightly after 2 months of continuous negative nitrogen balance.

There was a marked difference in the utilisation of the concentrates; gluten feed showed a percentage efficiency of 45, oil meal 61, distiller's grains 60, casein 59, and skim milk powder 60. These data represent the efficiency in the mixture used.

(1) See B. August, 1915, No. 831. (Ed.)

II. — In the preceding article the writers pointed out that the comparison would probably hold only for the mixture studied and that a different behaviour might be expected should the basal ration be varied. These expectations were entirely confirmed by the results given in this paper, which are summarised as follows: —

The concentrates involving gluten feed, oil meal, distiller's grains and cottonseed meal, furnished approximately 40 per cent of the digestible protein of the ration and were used to supplement a basal ration of maize meal, maize silage, and clover hay. The total protein intake constituted about 12 per cent of the dry matter of the ration and the nutritive ratio was approximately 1:8.5. On this low protein intake positive nitrogen balances were maintained during most of the period of observation (16 weeks) with a slow shrinkage in milk volume, but a maintenance of the percentage composition of the milk.

Earlier records showed the inferiority of the proteins of gluten feed as a supplement to the proteins of maize meal and maize stover for milk production to those of oil meal, distiller's grains, or milk. These records show an equality in efficiency between the proteins of gluten feed, oil meal, distiller's grains, and cottonseed meal as supplements to the proteins of maize meal and clover hay for milk production.

These facts must emphasize in a very striking manner the limitations of any classification of natural foods in respect to the efficiency of their proteins, based on the determination of such nutritive worth in a single food material or a single food mixture.

889 — **A Cross Between a Goat and a Ram, in Brazil.** — SEIXAS, DANTON DE, in *A. Estancio*, Year VI, No. 3, pp. 57-60 + 4 Figs. Porto Alegre, March, 1918.

An common 3-year black-marked goat, served by a common white ram bore two healthy kids having the characters of both the parents. A photo accompanying the article shows one of them with white wool (belonging to the author at Porto Alegre, Brazil).

890 — **Study on the Land and Fresh-water Snails of Indo-China.** — DEMANGE, V., in the *Bulletin économique de l'Indochine*, Year XXI, New Series, No. 128, pp. 88-100 + 6 Plates of 27 col. Figs. Hanoi-Haiphong, January-February, 1918.

The poorer classes in Indo-China use land, and especially fresh-water, snails very largely as food, enormous quantities being consumed. The mother of pearl has only recently been exploited and will probably be of importance in the future.

A description of 20 fresh-water and 3 land species is given, together with the Latin and Annamite names.

#### FARM ENGINEERING.

891 — **Electricity in Agriculture: Consumption, Distribution and Ploughing.** — TARCHETTI, A., in *Il Giornale di Riscicoltura*, Year VIII, N° 2, pp. 25-30, No. 3, pp. 41-47. Vercelli, February 28 and March 31, 1918.

CONSUMPTION. — From the standpoint of Piedmontese conditions, where the soil is mostly average, with a resistance of 40 to 60 kg. per sq. metre of soil ploughed, the author calculated that, for a normal ploughing

at 15 to 25 cm. deep, the theoretical work per hectare would be an average of  $1\,000\,000 \times 50 \times 0.20 = 10$  million kilogrammetres, corresponding to a consumption of 27.2 kw.-hour, but as electric ploughs do not yield more than 50 %, the average energy consumed would not be less than 50 kilowatt-hours per hectare (1). The societies for the application of electricity to agriculture in Piedmont, where a million hectares could be cultivated in this way, ought to study the outline of the chief lines, the quality and tension of the current, and the conditions of sale of electrical energy to farmers.

**DISTRIBUTION.** — As the plough has to be moved from one field to another, the electric motor has to be supplied with current no matter where it moves. Thus a short, movable, low-tension line is needed, joined to a fixed or movable transformer cabin, which is connected to the main supply by a second, high-tension line, either fixed or loose. The author is convinced that to assure safe and easy electric ploughing, it is absolutely necessary to fix permanent secondary lines and establish transformer stations. The supply companies should be paid to fix the secondary lines and run the transformer stations themselves, without which the author is certain that there will never be any great development of electric ploughing.

The author thinks that economic and practical difficulties could be solved by using motors of as high tension as possible, always providing for the safety of the workmen, so that the low-tension line would allow of the cabin being moved without any notable fall of potential, while making it lighter and easier to handle.

Taking the case of a cable machine that can plough 100 hectares per station, there is a maximum radius of 550 metres; if the low-tension wire can be prolonged up to 500 metres from the transformer, a single station could serve about 350 hectares, which would correspond to the annual working capacity not of 1, but of 2 ploughing machines. But if a continuous current was available (or if the alternating current was transformed in the same cabin by means of a converter or a static mercury rectifier), at the same time raising the tension up to 500 volts even and eliminating anxiety for losses in yield from the 3-phase motors on account of the decrease of the power factors, the effective radius of the cabin might be increased to more than 1 300 metres, or over an area of more than 500 hectares.

It is obvious that, under such conditions, the installation cost of a short, permanent, secondary line and a fixed transformer station is slightly compensated for by the surplus energy that the station can supply without including:—

- 1) the small cost of upkeep and greater working safety;
- 2) the possibility, even the desirability, of using fixed, secondary lines of steel, iron or even copper;
- 3) the possibility of using oil-cooled transformers, surer and better

(1) In the ricefields in the Vercelli region (Sig. SEMENZA and A. TARCHETTI, "Le prove di aratura elettrica in risaia", Ed. Società An. d'Elettricità Alta Italia, 1915), on light soils (37 kg. per sq. dm.) at 23 cm. deep, a consumption of 48.3 kw.-hour, measured at the transformer, was found for a cable machine.

yielding and of such a power that several machines could be working simultaneously.

**PLOUGHING.** — The author reviews the FOWLER, HOWARD, and ZIMMERMANN (1) systems as regards their use in Italy. He notes that the last system (cable haulage) has been recently applied to a PATUZZO machine by the engineer G. GOLA. In the GOLA apparatus, the insulated and live conductor consists of a movable aerial wire parallel to the furrows, easily transportable, mounted on terminal stretchers and intermediate posts; an ingenious counterpoise arrangement assures the constant contact of the tackle, which, sliding on the line, transmits the current to the motor, through a trolley. However, the author states that it is awkward to move the line in practice, two such lines being required for continuous working, and they have to be moved every 8 or 10 yards of breadth of ploughing.

As regards direct electric traction, the author thinks that the difficulty of supplying current when turning necessitates the disuse of one-way motor ploughs, and that the system should only be applied to balance ploughs.

**892 — The Transformation of Motorcars and Motor-lorries into Agricultural Tractors and Windlasses (Landrin System).** — FÉREIR, V., in *Le Génie Rural*, Year X, No. 21, pp. 9-10 + 2 Figs. Paris, 1918.

M. MARCEL LANDRIN, of Soissons (Aisne, France), has devised two arrangements for transforming existing motorcar frames and motor-lorries into agricultural tractors and windlasses.

In the first device, between the ordinary driving and steering wheels are fitted 2 large diameter driving wheels with narrow tyres, which, provided with projections on each side, give a good grip on any soil without causing any damage. These wheels are chain-driven from chain-wheels keyed onto the hub of the ordinary driving wheels. Under direct drive, the reduction gives a speed of about 3 miles per hour. The special wheels are connected to the frame by springs that allow of sufficient suppleness to avoid strain. When the vehicle runs on the road the springs of the ordinary driving wheels are free, whilst the springs of the special wheels are kept compressed, so that the latter wheels are raised some 8 inches above the ground. For work in the fields, however, the compression on the springs is reversed, by means of an easy lever-movement, and the special wheels are used for driving while the ordinary driving wheels are lifted above the ground and only serve to convey the power. The axle of the special wheels is such that it carries nearly all the weight of the frame, using it to obtain grip.

The wheel base being thus much reduced, turning is carried out in a very short radius. Turning is facilitated by independent brakes for each wheel and by detachable hoops, mounted by the side of the steering wheels and which penetrate an inch or so in the soil. The draw bar hook for at-

(1) See *R.*, 1917, No. 1262, (F&A)

taching the implements is fixed as low as possible in front of the axle of the special wheels. Traction thus helps steering while adding to the grip of the driving wheels. This device allows of a vehicle being used equally well as a tractor or for transport. The device for transforming a motor lorry into an agricultural windlass is recommended for high-powered machines. It consists of a shaft placed on the frame above the back axle. The shaft carries 2 large windlass drums with internal teeth which engage with 2 wheels fixed on the interior of the driving wheels. The reduction is such that the cable speed is 3 miles per hour, in direct drive, the engine running at its normal rate.

The cables unroll in a direction parallel to the longitudinal axis of the frame, passing through two guides; because of the large diameter of the drums and the reduced breadth of the groove, the cables unroll quite easily. The equal tension of the two cables is provided for by the differential, which is an excellent compensator.

For moving sideways the front of the frame is carried on a small truck with 4 steering wheels and the back part on 2 detachable wheels. The movement is obtained by a capstan fixed on the drums or by a small windlass hauling on a fixed point. The back axle is held by grips that keep it in the required position. To move from the field, the drums are freed from the gears, the detachable wheels are removed and the back axle freed, and the small cart removed that supported the front frame. Thus small cart, which carries the accessories, is hooked behind the frame together with the plough, so that the whole machine moves under its own power. The machine can be removed and set up again very quickly. It would be particularly useful to sugar manufacturers, as by means of it they could haul their stores with 5 to 6 ton lorries towing trailers and then plough the land of the farmers that grow sugar-beets for them.

893 - **A Study of the Plough Bottom and its Action upon the Furrow Slice.** — WHITE, E. A., Assistant Prof. of Farm Mechanics, College of Agric. of the University of Illinois, in the *Journal of Agricultural Research*, Vol. XII, No. 4, pp. 145-182 — 20 Figs., — 4 Plates. Washington, January 28, 1918.

Geometrically exact mouldboards (plough bottoms) have often provided the basis for more perfect developments, but the results obtained by empirical plough designers were so far superior to the results obtained in the laboratory that the theories were abandoned, the makers basing their work on practical experience only.

This paper is an attempt to begin a fundamental analysis of the plough bottom and its work, in the hope that some light may be thrown on the work, and other attempts stimulated to study the theory of this important implement. The writer's work can be divided into 3 parts: — 1) a study of the forms of plough bottoms; 2) an attempt to analyse the motion of the soil particles as they pass over the surface, and 3) a mathematical analysis of the surfaces of the most important historical plough bottoms which were designed to be geometrically exact.

For this work the author developed the equation for determining the surface of a plough bottom.



In studying the motion of the soil particles in ploughing, observations were carried out in grass-land with a sod plough in order to determine the compression or stretching of the furrow slice and the movement (speed and acceleration) of the soil particles composing the furrow slice. The observations obtained are discussed in detail, and some are supported by the mathematical results obtained.

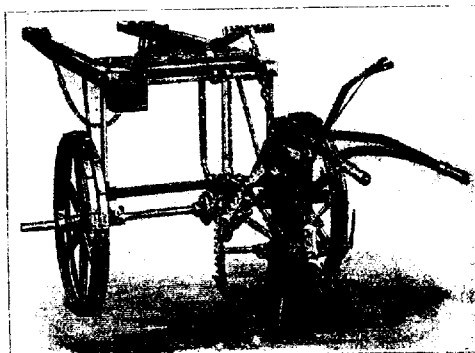
The mathematical analysis of the mould board surfaces includes a study of the mould boards of JEFFERSON, LAMBRUSCHINI, SMALL, STEPHEN, RHAM, KNOX, MEAD, and HOLBROOK.

The author also discusses mould boards by DAVIS (1818), WITHEROW & PIERCE (1839), for which he had not sufficient data to enable him to develop the equations for calculating the surface.

894 - **The Russell Turnip Thinner.** — *The Implement and Machinery Review*, Vol. XXXIV No. 517, p. 72 + 1 Fig. London, May 1, 1918.

There exists no turnip thinner that leaves only a single plant, but with a good machine, it is possible to leave a very small bunch of plants at regular intervals. A satisfactory machine which has proved its worth has been constructed by the MALDEN IRON WORKS CO., Ltd., Maldon, Essex. It may be used for thinning roots in general.

The RUSSELL thinner shown in the appended figure is provided with a serrated cutter, which can be quickly adjusted to leave very small or large bunches of plants. The thinning apparatus is nicely balanced, and is entirely under the control of the man working the machine. If the crop is patchy, the attendant can lift the cutters so that plants required to be left in are not taken out. The machine is fitted with 5 speeds, for gapping 8, 10, 12, 14 or 16 inches, whilst the cutting apparatus and road wheels are arranged to slide along the axle to suit varying widths of row.



The RUSSELL turnip thinner.

895 - The "Universal" Electric-drive Thresher. — *Schweizerische Landwirtschaftliche Zeitschrift*, Year XLVI, No. 22, pp. 462-465 + 2 Figs. Zurich, May 31, 1918.

This thresher, built by H. WOLF & Co., of Zurich (Switzerland), includes a wagon frame mounted on 4 wheels, at the back of which is placed the closed box containing the motor. The box contains the motor, the cut-out, and a drum with 325 to 650 feet of cable. On the front of the frame a thresher is mounted with a straw shaker, caving screen, elevator and bagging device. The machine is driven directly by the motor. The belts can be tightened as required, a spring friction-roller being provided. The feeding table and the straw delivery should not be removed for transport, so that the machine can start working in a few minutes. When the threshing season is over, the thresher can be removed by unscrewing 4 screws; a circular saw or other machine can then be mounted on the frame so that the motor can be used all the year round, which is a distinct advantage.

896 - Safety Devices for Chaff-cutters. — I. MASSARELLI, F., in *La sicurezza e l'igiene nell'Industria*, Year III, No. 6, pp. 131-147 + 19 Figs. Milan, December 31, 1916. — II. BERTONI, C., in *Il Coltivatore*, Year LXIV, No. 1, pp. 6-10, + 3 Figs. Casale, January 10, 1918.

The author considers fly-wheel chaff cutters, which are the most used, and the means of preventing the accidents that are so common with these machines. \* These accidents can be classified as: — a) accidents due to the fly-wheel; b) accidents due to the feed rollers, c) accidents due to the gearing and drive in general. The safety devices applied to chaff-cutters are based on two different principles: —

1) Devices stopping or changing the movement of the feed rollers and platform by quickly moving suitable mechanisms by the hand or foot. The devices, though improving the working qualities of the machine, are only relatively efficacious, as they are rather *attenuating* than *preventive* devices and should be supplemented by others.

2) Devices, automatic or not, that make it impossible to pass the arm or hand beyond a certain limit into the mouth where the forage enters. For hand-driven fly-wheel chaff-cutters, the author describes guards, made of wood, cast iron, sheet iron, or grating. As regards protection against accidents that might happen when feeding the machine, a beard, fixed on the edge of the hopper, and of sufficient length, will prevent the arm passing beyond a safe limit.

One of the essential conditions for the safety of machine-driven chaff-cutters is that there should be both a fixed and free pulley together with the disengaging gear that is so often lacking in the older machines. It should be so made that the belt cannot suddenly slip from the free on to the fixed pulley and thus start the machine. A lever disengaging gear mounted on a bracket is very suitable for belt-driven chaff-cutters, which should have a guard for the fly-wheel and a lattice protecting the knives.

This lattice, even when lowered on the feed-trough, allows the workman to see the position of his hands and watch the work more closely, and as it is connected by a lever to the side mechanism controlling the cylin-

ders and feed platform, if the workman's hands happen to pass into a dangerous position, the lattice lifts, thus stopping or reversing the movement

897 — **Balance for the Direct Reading of the Lint Percentage of Cotton.** — See No. 866 of this Review.

898 — **The Gibaudan Alcohol-meter.** — FOURNIER, L., in *Le Génie Civil*, Year XXXVIII, Vol. LXXII, No. 19, pp. 338-340 + 7 Figs. Paris, May 11, 1918.

The Company for the manufacture of meters and supplies for gas-works, France, makes an alcohol-meter for use in agricultural and commercial distilleries, to measure separately the production of pure alcohol and distillation waters. The meter consists of a rectangular box rounded on its upper part. The front face bears the thermometric and alcohol-metric graduations on an arc of a circle placed high up, between the dials of the clockwork registering the distillation waters and pure alcohol. Two air-bubble levels enable the apparatus to be levelled. Behind are the connections by which the liquid arrives and flows away, together with a by-pass so that the apparatus can be cut out without stopping distillation.

The measurement and recording of the pure alcohol are done automatically in the new meter, which discharges in quantities equal to the capacity of an interior measuring fly-wheel (constant volume), recorded by the distillation-water clockwork, then estimates the alcohol for each of them, the pure alcohol at 15° C being shown on a second dial.

The meter includes : — 1) a measuring fly-wheel consisting of a metal cylinder with thin walls, divided internally into 5 compartments by oblique partitions and worked by the weight of the liquid, which enters by an axial pentrough and then passes from the first compartment into the second, and so on ; 2) an alcohol-meter ; 3) a thermometer ; 4) a registering device.

A detailed description, illustrated by the necessary drawings, is given of the construction of the meter ; the mechanical connection of the various parts is also described in order to show the relation between them and the device recording the volumes of distillation water and pure alcohol.

#### 899 — Review of Patents.

TILLAGE MACHINES AND IMPLEMENTS. — *Canada* : 181634 Plough ; 181699 Plough share ; 181935 Scraper for disc plough.

*Denmark* : 22816 Motor plough.

*France* : 486652 System of ploughing and windlass apparatus for its actuation.

*Sweden* : 41808 Moss plough.

*United Kingdom* : 114516 Combined motor plough and tractor ; 114894 Self propelled plough.

*United States* : 1261150 Stalk cutting attachment for ploughs ; 1261579 Cultivating implement ; 1261591-1262867-1262949-1262950 Ploughs ; 1261876 Clod crusher ; 1261881 Rotary harrow ; 1262176 Two furrow plough ; 1262232 Convertible hillside reversible plough, 1262253 Soil pulverizer ; 1262722 Two way plough ; 1262791-1262792-1263352 Rotary

illers; 1262983-1264447-1264678 Harrows; 1262995 Wheeled plough; 1263422 Wheel harrow; 1263423 Harrow tooth cleaner; 1263690 Harrow attachment for plough.

IRRIGATION. — *United States*: 1261031 Ditching machine.

MANURES AND MANURE DISTRIBUTORS. — *Sweden*: 41960 Manure spreader.

*United States*: 1261025 Fertilizer; 1261116 Process for making a mixed potash, nitrogenous and phosphatic fertilizer; 1261117 Process of making mixed potash and nitrogen fertilizer; 1262685 Fertilizer distributor and planter; 1263105 Seed and fertilizer distributor; 1264409 Straw spreader and grain separator.

DRILLS AND SEEDING MACHINES. — *Canada*: 181787 Potato planter.

*Sweden*: 42039 Distributor regulating device for seeding machine.

*United Kingdom*: 114455 Potato planter.

*United States*: 1261291-1262084-1264454 Planters; 1262142 Potato planter; 1262283-1264153 Grain drills; 1263070 Harrow attachment for planters; 1263105 Seed and fertilizer attachment; 1263111 Combined cultivator and seed and fertilizer implement.

VARIOUS CULTURAL OPERATIONS. — *Sweden*: 41807 Hoe for root crops; 41921 Horse hoe.

*United States*: 1261720 Cotton chopper and cultivator; 1262230 Hand cultivator; 1262418 Double cultivator; 1262800 Maize cultivator; 1264102 Four wheeled cultivator; 1264419 Plant protector.

CONTROL OF DISEASES AND PESTS OF PLANTS. — *United Kingdom*: 114602 Powdered insecticide composed of copper sulphate and ammonium carbonate.

*United States*: 1263312 Boll weevil destroying machine; 1263965 Weed cutter.

REAPERS, MOWERS AND HARVESTING MACHINES. — *Sweden*: 41809-41810 Horse rakes.

*Switzerland*: 78221 Fruit gathering device.

*United States*: 1261020 Lawn mower; 1261202 Machine for gathering crimson clover seed; 1261241 Revolving hay rack; 1261404-1261653-1263540 Grain shockers; 1261529 Corn husker; 1261702 Attachment converting binders into headers; 1261860 Binding mechanism for grain binder; 1262030-1262031-1264575 Cotton pickers; 1262340 Guard-plate for hay rake; 1262353-1263149-1263183-1264264 Peasant harvesters; 1262658 Mower; 1262756 Conveyor-rake and stacker; 1262957 Maize shocker; 1263001 Motor driven header and binder; 1263321 Hay rake; 1264154 Stooking attachment for binders; 1264353 Hay rake and loader; 1264385 Bean harvester; 1264780 Fruit gatherer.

MACHINES FOR LIFTING ROOT CROPS. — *Denmark*: 22862-22884 Potato diggers.

*United States*: 1261139 Potato digger; 1261227 Riding beet puller; 1261333-1263520 Beet harvesters; 1263114 Separator for potato digger; 1263408 Elevating and topping mechanism for beet harvester; 1264111 Root harvester.

THRESHING AND WINNOWER MACHINES. — *Denmark*: 22879 Feeder for cleaning machines.

*Sweden*: 41851 Straw elevator.

*United States*: 1261299 Seed separator; 1261338 Feeder for threshing machine; 1261562 Band cutter and feeder for threshing machine; 1261629 Pea huller; 1261813-1262760-1263233-1263980 Threshing machines; 1262423 Maize grader and separator; 1262559 Pea and bean separator; 1263130 Green pea hulling machine.

MACHINES AND IMPLEMENTS FOR THE PREPARATION AND STORAGE OF GRAIN, FODDER, ETC. — *Denmark*: 22838 Improvement to a self binding straw-press; 22890 Straw press.

*Sweden*: 41850 Knife for root cutter.

*United Kingdom*: 114435 Machine for obtaining fibre from cotton seeds and other fibre bearing seeds.

*United States*: 1261051-1261931-1263322 Baling presses; 1261522-1261597-1264171 Hay distributing apparatus; 1261651-1264645 Silage packer; 1261728 Cotton seed delinter; 1262615 Hemp cleaner.

FORESTRY. — *Canada*: 181567 Wood sawing machine; 181638 Bark ing machinery.

*United States*: 1261760-1263495 Stump pulling machines; 1263385 Tree sawing machine.

STEERING AND TRACTION OF AGRICULTURAL MACHINERY. — *United Kingdom*: 114377 Agricultural tractor; 114516 Combined motorplough and tractor; 114943 Plough coupling to tractor; 114668 Harvesting machine driving mechanism.

*United States*: 1261263-1261388-1261701-1262488-1263726 Tractors; 1261584 Steering mechanism for tractor; 1261945 Chain tractor tread; 1262100-1263973 Four wheel drive tractors; 1262304 Traction engine driving mechanism; 1262456 Automatic draft releasing device for tractor; 1262625 Steering device for motor propelled plough; 1262837 Tractor driving gear.

HOUSING LIVESTOCK. — *Switzerland*: 78223 Automatic releasing device for cattle in stables or barns.

POULTRY FARMING. — *United States*: 1262397 Incubator; 1262680 Poultry perch.

INDUSTRIES DEPENDING ON PLANT PRODUCTS. — *Canada*: 181952 Bread making process.

*United States*: 1262872 Process for producing fibrous material from ricestraw; 1263742 Device for cutting and seeding peaches and other similar fruits; 1263922 Fruit paring and coring device.

DAIRYING. — *Sweden*: 41879-41880-42011 Rotary churns.

*Switzerland*: 78098-78268 Churns.

*United Kingdom*: 114713 Churn.

*United States*: 1261780-1264214 Milking machines; 1261820 Method of manufacturing a butter substitute (with butter, milk, eggs); 1263347 Teat cup claw for milking apparatus; 1264336 Sterile butter fat and method of producing the same; 1264377 Valve caging for milking machine

FARM BUILDINGS. — *United States*: 1261454-1264689 Silos.

VARIOUS. — *Denmark*: 22903 Windmill regulator.

*United States*: 1263326 Windmill.

900 - **Rapid House Construction with Concrete Studs.** — *Engineering News-Record*, Vol. LXXX, No. 13, pp. 601-606 + 3 Figs. + 2 Plans. New York, March 28, 1918.

The description of a new method of house construction with fire-resistant walls made of cement stucco on metal laths.

The system proposed by Mr. E. G. PERROT, of BALLINGER and PERROT, engineers and architects, Philadelphia, allows of building 10-unit rows, each house costing, at present prices of labour and materials, about \$2 500, including the cost of hot-air heating apparatus. The price is as low as that of similar houses of wood frame construction and is \$100 lower per house than where 8-in. brick walls are used for exterior and party walls.

The concreting is carried out in one operation, in which both the frame members and stucco are placed. After the cellar is excavated a stone or concrete foundation wall is built, and the first-floor wood joists are set in place on the foundation walls. On these joists a wood frame consisting of studs, joists and rafters is erected in the usual manner of building a frame house. Every fourth stud is doubled, allowing a 3 × 4-in. space between, which is later filled with concrete to form a concrete stud. At the second-floor and roof levels a ledger board with bottom attached is placed over the studs and so arranged that the concrete when completed will be continuous from foundation to roof. On top of the ledger board the second-floor joists are set, then the second-story studs and forms. When this frame is completed, heavy waterproof paper is nailed to the outside of the exterior wall studs, leaving the space between the doubled studs open to receive the concrete. Over the waterproofed paper the metal lath or concrete reinforcement is stretched. The concrete studs are reinforced with steel rods fastened to the metal lath.

The wood studs not only support the cement stucco while it is being applied, but also serve as furring strips in the finished building. A 2-in. concrete coating is next applied on the outside, and at the same time the spaces between the doubled studs and in the ledger boards are filled to form the concrete studs and caps. The work is preferably done with the cement gun, otherwise it is done by hand. The rapidity of the work depends only upon the number of cement guns used, or the number of workmen employed.

A concrete roof may be used on such a house, but Mr. PERROT prefers wood roof framing and a fire-resisting covering (asbestos and asphalted-felt shingles, slate, and built-up roofings of felt, tar and gravel).

According to the designers this method of construction eliminates shrinkage and settlement cracks. A ten-house unit can be built in 3 weeks from the time the cellar is dug. The method is considered to be well adapted for building barracks, hospitals and one-story factories.

## RURAL ECONOMICS.

901 - **Study of some Egyptian Farms.** — BAROIS, C., in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 13, pp. 117-127. Paris, April 10, 1918.

At the Meeting of April 10, 1918 of the French "Académie d'Agriculture", the author described some capitalist farms in Egypt with the intention of pointing out to the French public the advantages capitalist colonial agricultural enterprise, if well managed, may offer to French investment. Five farms, those of *Kom-Ombo*, *Cheikh Fadi*, *Onady Tounilat*, *Sakha*, and *Santa* were studied.

**KOM-OMBO FARM.** — In 1903 a company bought from the Egyptian government 32 124 acres on the banks of the Nile in a plain 1 760 miles south of Cairo by 24.5° northern latitude. It was absolutely desert land, never reached by the waters of the river, with a minimum height of 37.16 to 49.20 feet above low water level. The soil was not composed of Nile alluvion, but of deposit from the neighbouring valleys. The climate was tropical. These 32 124 acres cost £ 11 597, or about 7s. 2d. per acre.

The problem to be solved was to raise mechanically and distribute the water of the Nile in all seasons to the highest point of the estate, and to render fit for cultivation land which had not only never been cultivated, but had never borne any kind of plant. Four powerful pumps of 1 400 HP., each with sheet steel delivery pipes 6 ½ feet in diameter and 1640 feet long were installed, 110 miles of road, 121 miles of railway, and about 220 miles of canal were built, numerous buildings for the pumps, staff, peasants (school, mosque, hotel, etc.) erected, and the land levelled and prepared.

The total cost of the original installation was nearly £981 310, or £4 per acre for the 22 980 acres now under cultivation. The estate, uninhabited before the work began, now counts a population of 20 000 inhabitants.

After five years of not always successful experiments in the growing of cotton besides cereals, beans and fodder (winter crops), and maize (alternate summer crop), cotton is at last being replaced by sugar cane. In 1916, the cultivation of sugar cane which covered only 27 % of the area cultivated, brought in a gross profit of £150 666, as compared with £79 298 from all the other crops together.

The annual farming expenses are £194 280, corresponding to £8.10.0 per acre, including 14s. in taxes. These figures include £1.18.6 per acre for raising the water, and, in 1913, represented a profit of 5 ½ %.

The land is cultivated either by the tenants for the ordinary crops, or in conjunction with the fellahs and the company for these crops and for cotton, or directly for sugar cane. In all cases the pumping expenses are met by the company. For direct cultivation the estate is divided into farms of 1 977 to 2 471 acres, each with its directing staff, workmen and material. The utilisation of motive power from the Assouan dam and the adaptation of cotton to the land improved by irrigation are expected to make the enterprise very prosperous.

**CHEIKH FADI FARM.** — This farm is situated in central Egypt, a district suited to the production of cotton and sugar cane. It is an example

of an estate, previously fairly badly managed, taken over by a company, improved by it, and cultivated exclusively by farmers. The land is on the right bank of the Nile, between the river and the Arabian plain. It does not receive the river water directly, and can only be irrigated by pumping; it is of average quality.

The estate contains 9 204 acres. The company with a capital of £594 700 bought it from the Egyptian Government in 1900. The cost of the original installation was:—land (cost and preparation), £566 000; buildings, £24 680; machines and steam-ploughs, £33 750; dredging machines, 1410; miscellaneous expenses, £7 070, or a total of £632 910, and represents an outlay of about £70 per acre.

All the land is let out to farmers. The irrigation water is supplied by the company.

Besides cereals, beans, maize and clover, which are included in the rotations, the principal crop is sugar cane. The chief tenant is a large sugar company which cultivates 6857 of the 9204 acres of the estate. The receipts for 1915-1916 were:—rents, £46 620; miscellaneous receipts, £660; interest, £1 380, or a total of £48 660. The expenditure was:—farming expenses, £11 280, general expenses £3 140, a total of £14 420. There was, therefore, a profit of £32 240. The average rent is £5 per acre, and the company's annual outlay about £11.11.0 per acre. Each year the company pays its shareholders 5  $\frac{1}{2}$  %, and in 1916, after 15 years' existence, its reserve fund exceeded £39 650.

**OUADY TOUMILAT FARM.**—This farm is of a totally different character. It is an estate of 21 250 acres, most of which has deteriorated owing to the infiltration from a large public canal. In 1891 only 7 412 acres were still cultivated, 3 460 acres were occupied by canals or were fallow, and 10 378 acres were considered suitable for cultivation if drained.

The estate is in a hollow in the desert between the Delta and the Suez Canal. It was exploited by the administration of the Wakfs (religious endowments) and the profits devoted to the maintenance of the Government schools. From 1892 to 1895, £29 130 were spent on building:—1) a water-raising plant with four large centrifugal pumps to raise the drainage water to a height of 8.85 feet in the neighbouring Lake Mahsamah; 2) a feeding canal over 48 miles long; 3) a drainage canal over 13 miles long.

Owing to the neglect of the Wakfs these works did not improve the condition of the estate, and, in 1890, the area suitable for cultivation had not increased. The Ministry of Public Works then undertook the management of the estate with the intention of completing the drainage works as well as of clearing the 10 378 acres capable of being reclaimed for cultivation.

The necessity of increasing the power of the water-raising plant and to empty the overflow from Lake Mahsamah into the Suez Canal by means of a canal nearly 55 miles long was first recognised. By the end of 1906 7 265 acres had been reclaimed for cultivation and only 3 113 acres remained to be cleared. The advance money for the works, amounting to £46 400 had been entirely repaid to the Wakfs from the profits from the farm; the taxes of £5 947 had been paid regularly and, in addition, an annual income of



£8 250 had been paid to the Government schools. The work of clearing was then continued using the annual profits, which increased progressively. In 1916, when the work of clearing had been finished, the net income of the estate was £31 323, or about £1.15.0 per acre cultivated.

In the Ouady Toumilat district the soil is light and of inferior quality. As throughout all Lower Egypt the principal crops are cereals, clover, maize, and cotton.

The agricultural population which in 1891 was reduced to 4 500 inhabitants, is now 17 000, about 5 000 of whom are workmen. Thanks to the reclamation work undertaken since 1891, the cost of which has exceeded £99 120, or £9.10.0 per acre reclaimed, this estate is once more prosperous.

**SAKHA AND SANTA FARMS.** — These are two estates with abundant yields situated in the best part of the Delta. The **SAKHA** estate with 6 412 acres of good, average quality land, is managed by a State Administration called "Egyptian State Properties", that is to say, it is methodically, but extensively managed, as is the case with all State administration.

The land is partly cultivated directly by the Administration, partly leased yearly, let to workmen for a quit-rent, or leased for special crops. In 1914, 4 146 acres were being directly cultivated with the following rotations and yields: —

Wheat, 410 acres, 19.08 bushels; barley, 175 acres, 33.28 bushels; beans, 640 acres, 22.65 bushels; clover, 783 acres; cotton, 1 907 acres, 2.93 cwt.; gardens, 10 acres.

The Administration reserves the cultivation of cotton exclusively to itself, leaving that of maize to the tenants. The receipts for the whole estate, including the crops grown directly, rents and quit-rents were £44 682; the expenditure £25 144; the balance, therefore, is £19 538. The receipts amount to £7 per acre, the expenditure £4, and the profits £3. The taxes are 16s. per acre.

The **SANTA** farm, in Lower Egypt, is also demesial, and has land of the best quality. It contains 11 794 acres, 6 635 of which are cultivated directly and the remainder by annual leases and quit-rents, like the Sakha estate.

The results are superior to the preceding ones. The rotations and yields for the crops grown directly were, in 1912: — Wheat, 1 243 acres, 29.90 bushels; barley, 655 acres, 49.54 bushels; beans, 329 acres, 20.02 bushels; clover, 1 517, 20.65 bushels; cotton, 2 874 acres, 4.13 cwt.; gardens, 15 acres.

For the whole estate including crops cultivated directly, leases and quit-rents, the receipts were £139 043, the expenditure £63 220, and the profits £75 823. This represents receipts equal to £11.16.0 per acre, expenditure of £5.7.0 per acre, and profits of £6.9.0 per acre. The taxes are £1.9.1.0 per acre.

These examples show the profits which might be derived from similar districts in the French colonies, so long as individual initiative is supported by sufficiently large capital aided by competent management. Above all such large enterprises should not be entered upon before the subject has been thoroughly studied and numerous extensive experiments made.

302 - **Studies in the Cost of Market Milk Production in the United States.**—ANDERSON, A. C. and RIDGELL, F. T. (Michigan Agric. Exp. Station), in *The Journal of Dairy Science*, Vol. I, No. 2, pp. 181-184, Baltimore, July, 1917.

The data presented in these studies cover a period of two years, from 1914 to 1916, and include figures from 25 farms near Grand Rapids, Michigan. Most of the other figures secured on this point in the United States were collected in New England or Atlantic Coast States. The data were secured by a one day visit to each farm monthly. All the farms visited produced market milk, some of them being dairy farms solely, although most of them were coupled with grain, vegetables, live stock or fruit production, and each farm was conducted according to the ideas of the owner or operator. The average expenditures of the farms visited were as shown in Table I.

TABLE I. — *Average expenditures.*

Items of expenditure	1914	1915
Total number of farms . . . . .	25	25
Average number of cows per year . . . . .	450.4	428.57
Man labour . . . . .	\$ 287.8	271.19
Hauling milk and other horse labour . . . . .	15.54	14.77
Feeds:		
Roughage . . . . .	310.2	305.88
Concentrations . . . . .	28.01	26.68
Pastures . . . . .	8.30	7.6
Cash sundries . . . . .	1.99	1.77
Veterinary services and drugs . . . . .	0.86	0.99
Taxes, interest and depreciation on land . . . . .	9.88	9.40
Taxes, interest, insurance and depreciation on buildings . . . . .	8.72	10.33
Depreciation on barn tools and dairy utensils . . . . .	0.10	0.48
Actual losses on live stock . . . . .	1.05	0.25
Added learning power of owner due to knowledge, experience, and interest in excess of that possessed and used by ordinary labour . . . . .	6.00	6.00
Added risk due to instability of market for product as whole milk, which in single years amounts to 30 per cent, and in one year out of every five would be 6 per cent . . . . .	8.47	8.20
Total . . . . .	150.57	150.29

The average receipts of the farms visited, for the dairy, were as shown in Table II.

The authors bring in a new point, that of "instability of market for product as whole milk" which in a single year may amount to 30 per cent and occurs, as they estimate, one year in five, which would be 6% of the total cost of production, in this case \$ 8.47 for 1914 and \$ 8.30 for 1915.

TABLE II. -- *Average receipts.*

Items of receipts	1914	1915
Average pounds of milk produced . . . . .	6,928 lb.	7,156.8 lb.
Gallons of milk produced . . . . .	834.70 gal.	862.3 gal.
Average price per gallon delivered into Grand Rapids.	16.00 cents	16.35 cents
Value of milk produced . . . . .	\$ 141.35	\$ 139.01
Credit by manure . . . . .	17.45	17.59
Total value of products per cow . . . . .	158.80	156.60
Net profit per cow . . . . .	8.23	0.31
Cost of production per gallon . . . . .	15.90 cents	15.39 cents
Net profit per gallon . . . . .	1.0 cents	0.7 cents
Cost of production and delivery per hundred pounds . . . . .	\$ 1.916	\$ 1.854
Cost of production per quart . . . . .	3.475 cents	3.84 cents

The investment on the farms studied, expressed in percentage is as follows: --

Investment in cattle . . . . .	45 %
Investment in buildings . . . . .	54 "
Investment in equipment . . . . .	1 "

For 1915 the distribution of cost factors was as follows, expressed in percentage: --

Grain . . . . .	17.8 %	Taxes, interest and depreciation on buildings . . . . .	0.69%
Roughage . . . . .	29.2	Same on cows . . . . .	0.3
Pasture . . . . .	5.1	Losses on cows (tuberculosis, etc.) . . . . .	1.1
Hauling milk . . . . .	9.8	Management . . . . .	4.6
Man labour . . . . .	18.1	Depreciation on tools, etc. . . . .	0.3
Market losses . . . . .	5.5	Veterinary services . . . . .	0.7
		Cash items . . . . .	1.2

The authors point out that during the last two years the cost of labour has increased 25 %, concentrated feeds 30 to 35 %, roughage 10 %, and minor supplies and milk room equipment 25 to 60 per cent.

## AGRICULTURAL INDUSTRIES.

903 -- **The Intrinsic Values of Grain, Cottonseed, Flour and Similar Products, Based on the Dry-Matter Content.** -- BOEKER, H. G., U. S. Department of Agriculture, Bulletin No. 374, pp. 1-32 + 12 Tables + 3 Figs. Washington, D. C., October 17, 1916.

The moisture content of grains or cottonseed varies with the season, the part of the country in which they are grown, and the way they are handled and stored after being harvested. The minimum and maximum moisture content of grains, cottonseed, or their manufactured products generally varies between 10 to 30 %; new maize, however, frequently exceeds this maximum; whereas thoroughly dry small grain and cottonseed may contain less than 10 % of water.

All else being equal the value of grain, cottonseed, flour, meal, etc., to the consumer is in proportion to their content in dry matter. Moreover moisture is a serious hindrance to good keeping; enormous quantities of grain and cottonseed are seriously damaged each year by moulds and fermentation because their moisture content is too high for safe storage or transportation, and the danger of such damage increases with each additional percentage of moisture.

The value of a low moisture content has long been recognised in the trade, where the rules governing the grading of grain lay down that grain, to be classed in the higher grades must be "dry", in the intermediate grade "reasonably dry", and in the lowest grades "damp" or "wet". This classification is very indefinite, but it was only in 1916 that rules giving definite maximum limits of moisture for the various grades of corn were drawn up by the Grain Dealers' National Association, and adopted by the State grain inspection departments and grain exchanges. In 1914 the Department of Agriculture drew up grades for commercial maize and fixed definite limits of moisture for each of the six numerical grades. These grades are now in force in most of the maize markets in the United States. In certain States the pure-food laws also deal with the amount of moisture grain and flour may contain in order to enter the State.

When a unit of weight of grain, cottonseed, etc., containing excess moisture is dried naturally or artificially to a lower moisture content, the weight is reduced by the loss of water, but all the dry matter is retained. As only the dry matter is considered as having any value the total value before and after drying will be the same. The comparative value of the dry matter is, therefore, of great importance. The author gives a series of tables by which the comparative value, on a dry-matter basis, of grain, cottonseed, flour, etc., containing various percentages of moisture and quoted at various prices per unit of weight, may be easily and rapidly calculated. These tables show that the difference in value for each 1 % of dry matter increases in direct proportion to the increase in price, so that, as the price of the product increases, the difference in value for each 1 % of dry matter or moisture becomes of greater importance to the producer and consumer. Moreover, it is clear that if a dry product commands a better price than one with a high moisture content the farmer will be encouraged to improve his methods of farming and storing.

Grain, especially maize, is frequently put on the market with a moisture content too high to remain sound during storage or transportation, and has to be dried by machine. Whether dried naturally or artificially the shrinkage in weight of such grain is always greater than the difference in the percentage of moisture content before and after drying, as shown by the moisture tester, unless all the moisture is dried out, when the shrinkage and the reduction in moisture are equal. In order to facilitate the estimation of this percentage, the author gives a table by which the shrinkage may be determined when the original moisture content and the moisture content after drying are known. He also gives formulae for finding the percentage of shrinkage corresponding to any reduction in moisture content and for finding the weight of the dried

material when the original weight and the moisture content before and after drying are known.

In drawing up the tables only the fundamental factors of moisture and dry matter were considered; there are, however, other factors of equal importance in the buying and selling of cottonseed, flour and other products, among which may be mentioned: — 1) the relative quantity of damp grain in the grain-producing States that have a surplus, or in the district bordering on any given grain market, and the relative quantity of the market receipts; 2) the tendency of damp grain to deteriorate during storage or transit, and the increased danger of such deterioration as the moisture content increases; 3) the conditions of supply and demand at the time of marketing, and the relative capacity of the markets to absorb or dispose of damp grain at a profit; 4) weather conditions at the time of marketing and future weather conditions which may affect the condition and carrying capacity of the grain; 5) the extra cost incurred by the artificial drying of the grain and by the freight on the water handled; 6) the slight "invisible loss" in weight during the drying process.

904 — **The Utilisation of Sisal Waste for the Production of Alcohol.** — *Tropical Life*, Vol. XIII, No. 12, p. 155. London, Oct., 1917; Abstract in the *Bulletin économique de l'Indochine*, Year XXI, No. 125. New Series. Hanoï-Hiophong, January-February, 1918.

After the fibre has been extracted from sisal there remains much waste, which has a very disagreeable smell and, when possible, is used as a fertiliser. Investigations have been made to see whether this waste can be put to a more profitable use. The experiments dealt partly with its utilisation for paper-making and partly on the extraction of alcohol from the leaves and stems.

The experiments, made in British East Africa, show it is possible to extract alcohol from sisal. An analysis of the juice of the leaves showed the plants from the coast as well as those from the Highland to contain 3 % of sugar. At Yucatan, whence sisal was first exported and where alcohol has been made from the waste and put on the market, the sugar content was never below 0.4 %, and sometimes, after a long dry season, reached 14.1 %. Most of the alcohol was made from leaves containing 12 % of sugar.

A yeast was isolated from sisal plants which fermented a glucose solution but was quickly killed in the sisal extract. This was no doubt due to the large quantities of organic acids present. After neutralisation with sodium carbonate and the addition of a small quantity of glucose it was found possible for the yeast to live in the sisal extract, but no fermentation took place.

905 — **The Beet Sugar Industry in the Netherlands.** — GOOSSENS, G., in *In en Uitvoer*, Year III, Nos. 7 and 9, pp. 151-152 and 200-202. Antwerp, February 13 and 27, 1918.

After giving an historical survey of the beet sugar industry in the Netherlands the author gives the figures for the production of sugar in that country from 1864 to 1916. In 1864 there were only 6 refineries with a production of 3 700 metric tons of sugar, an average of 617 tons per factory.

In the period 1899 to 1900, 31 refineries were working and producing 71 062 metric tons of sugar, an average of 4 940 per factory. The 28 refineries working during 1912 to 1913 produced 279 000 metric tons, an average of 9 980 each. In 1916 the 28 refineries only produced 247 209 tons. A table giving the average yield of sugar beets per acre from 1908 to 1914 shows that, in 1908-1909, the yield was 260 cwt. of roots with a 16.86 % sugar content, yielding 43.75 cwt. of sugar. After dropping, in 1909, to 217 cwt. of roots containing 15.5 % of sugar, and yielding 33.58 cwt. of sugar per acre, the average yield of sugar beets rose in 1911-1912 to 286 cwt. of roots, containing 16.57 % sugar and yielding 47.61 cwt. of sugar per acre, and in 1913-1914, again dropped to 219 cwt. of 16.55 % roots giving 36.25 cwt. of sugar.

Besides the beets produced in the country the refineries also deal with beets imported from Germany. On the other hand the Netherlands also export beets into Belgium to be used by the factories there. The author considers the sugar position in the Netherlands during the last three years, and concludes that the production for 1917-1918, estimated at about 200 000 metric tons, will be sufficient to meet the demand for beet sugar there in 1918, which is estimated at about 170 000 metric tons.

906 — **The Fat of the Residue of the Decortication of Rice.** — GARELLI, FELICIO ARNALDI. *Atti R. Accademia d'Agricoltura di Torino*, Vol. LIX, pp. 132-136. Turin, 1917.

The annual production of rice in Italy exceeds 11 700 000 cwt.; the residue from decortication ("pala di riso") represents 980 000 cwt. and contains about 147 000 cwt. of oil. This residue is composed of the perisperm, embryo and part of the outermost starch layers of the caryopsis, to which, in the trade, are added varying quantities of husks. Without the husks it represents 7 to 8 % of the weight of the rough rice, but the commercial type represents about 10 % of this weight. Up to the present it has only been utilised in part as a food for cattle (1), and before the war, the greater part of it was exported (chiefly to Switzerland and Germany) and sold on a basis of its total fat + protein content, which varied from 15 or 16 % to 24 or 26 %.

By removing the fat from this product its keeping quality is improved, it is made more healthy (the fat is slightly irritating and relaxing) and easy to transport. The extract is of great value, especially at this moment when all the war industries require so much fat. Experiments on the extraction of this fat were, therefore, made.

Repeated pressure under 300 atmospheres each of nearly 2 cwt. of meal, previously moistened and heated, gave an average yield of 6.5 % of crude oil. The properties and characters of the fat vary greatly, especially according to the state of preservation of the residue, and also according to the method of preparation (by compression or volatile solvents). That prepared by compression is liquid at ordinary temperatures; it is a true oil with a density of 0.912, of a greenish-grey colour. The cake obtained by this method is similar in appearance to that of sesame seed.

(1) See R. 1007, *Ann. No. 507 Ann. No. 507 1911, No. 507 1912.*

The crude residue of decortication contains 2.38 % of nitrogen, corresponding to 14.87 % of crude protein which, together with 15.23 % of fat, gives a total value of 30.1 %. In the dried cake this value is 33.8 % (16.7 % of crude protein and 17.1 % of fat).

The extraction of this fat is of great value, and should be started immediately, leaving till later a detailed study of the possibility of complete extraction by volatile solvents. By the compression method it would be possible to obtain 39 200 to 58 800 cwt. of excellent oil for the manufacture of soap, fatty acids and glycerine.

907 — **South African Paper-making Plants.** — See No. 860 of this *Review*.

908 — **A Substitute for Litmus for Use in Milk Cultures.** — CLARK, W. M. and LUBS, H. A. (Research Laboratories, Dairy Division, Bureau of Animal Industry, U. S. Dept. of Agriculture), in the *Journal of Agricultural Research*, Vol. X, No. 3, pp. 105-111, Washington, D. C., July 16, 1917.

The colour changes which occur in litmus-milk cultures may be due to changes in the hydrogen-ion concentration of the medium or to reduction or even destruction of the dye. If it is the degree of acid or alkali fermentation which is sought, it is advisable to use an indicator which will not be affected except by a change in the hydrogen-ion concentration. Dibromorthocresolsulfonphthalein, for which the short name bromeresol purple is suggested, fulfills this condition.

Litmus undergoes a temporary reduction during sterilisation in the presence of milk. Bromeresol purple does not. The colouring power of litmus is relatively weak; bromeresol purple in very high dilution is useful. Litmus and azolitmin are indicators of uncertain composition; bromeresol purple is a definite individual compound obtainable in crystalline form and therefore reproducible. The impurities of litmus preparations vary in their effect upon the hydrogen-ion concentration of milk and often necessitate elaborate adjustment either of the litmus solution, of the milk, or of the mixture if reproducible colour is to be obtained. Bromeresol purple, on the other hand, may be used with the assurance that, if other conditions are constant, it will always produce the same colouration.

Some of the difficulty experienced in reproducing a particular initial colour with either indicator is shown to be due to the changes in hydrogen-ion concentration which occur when milk is sterilised by heat.

The comparative value of litmus and bromeresol purple in milk cultures was tested with a variety of organisms. It was found that no change in reaction could be observed with litmus which could not be followed equally well with bromeresol purple. In many instances litmus was rendered useless by reduction or destruction while bromeresol purple continued to act a true indicator of the hydrogen-ion concentration.

909 — **Preliminary Note on Certain Changes in Some of the Nitrogenous Constituents of Milk Caused by Bacteria.** — SCFFLEE, G. C., in *The Journal of Dairy Science*, Vol. I, No. 4, pp. 313-319, Baltimore & London, November, 1917.

The data presented in this preliminary note are the result of a preliminary investigation on certain quantitative changes in the nitrogenous

constituents of milk caused by bacteria before any change in the physical appearance of the milk is evident.

The following species of bacteria were used: *Bact. lactis acidi*, *Mic. allidus*, *Ps. liuefaciens*, *B. lactis viscosus*, *B. mycoides*, Acid peptoniser (species unknown), *Bact. bulgaricum*, *B. coli communior*, *Bact. aerogenes*, *B. prodigiosus*, *Ps. pyocyaneus*, *B. subtilis*.

The plan of the analyses was one of fractional precipitation by various precipitating reagents and the subsequent determination of the nitrogen in each of the fractions.

In many instances the changes in the nitrogen content of the various fractions were very slight. Many of the results, however, were beyond the realm of experimental error. A study of the tables presented reveals the following general results:—

All organisms tested except two caused a decrease in the casein fraction and in most cases this decrease was more marked with those organisms known to possess extreme proteolytic properties. With some organisms there was an increase in the albumin fraction, with others a decrease in the albumin fraction and little or no decrease in the casein fraction. The changes in the nitrogen content produced under these conditions will serve as a preliminary basis for further work.

910 • **Experiments on Determination of Cow Manure in Milk; Moisture Content and Solubility of Cow Manure.**—TAYLOR, G. B., in the *Journal of Dairy Science*, Vol. 1, No. 4, pp. 303-312. Baltimore & London, November, 1917.

A series of experiments was conducted on cow manure from the experimental farm at Beltsville to determine primarily whether the manure in unstrained milk can be measured quantitatively by chemical methods. A method was found which gave good results provided the original quantity of manure present was fairly large. For average milks, however, this chemical method is impractical on account of the fact that, while manure is always present, it is as a rule in such small amounts that it cannot be measured chemically.

The experiments lead to the conclusions given below.

**Conclusions:**—The moisture in the cow manure examined averaged nearly 83 per cent. Air dry manure contains about 6 per cent of moisture; 5 per cent of the remaining solid matter is soluble in milk. This would indicate that only 11 per cent of dry manure dissolved in milk, 6 per cent of this being water. Nearly 85 per cent of fresh cows' manure will dissolve in milk, 83 per cent. of this being moisture. Manure in whatever condition is less soluble in milk than in water. Of the manure present in bottled milk, 91 per cent will be visible on the bottom, leaving 9 per cent of foreign matter in suspension.

911 • **Methods Adopted in the Production of "Clotted Cream" in Devonshire and Cornwall, England.**—SADLER, W., in the *Journal of Dairy Science*, Vol. 1, No. 4, pp. 291-302. Baltimore & London, November, 1917.

Enquiries have been conducted on behalf of the Board of Agriculture as to the methods adopted by the producers of "clotted cream" in the counties of Devonshire and Cornwall in England. Experiments have subse-



quently been undertaken at the Midland Agricultural and Dairy College, Kingston, Derby.

The results of these experiments so far tend to show :—

- 1) That provided a suitable system be adopted and reasonable care be taken in management and manipulation, clotted cream having the typical and characteristic properties can be produced in any district.
- 2) That, while a rich milk is preferable, it is not at all essential for the production of characteristic clotted cream to have only the breeds of cattle favoured by the producers in Devonshire and Cornwall.
- 3) That the flavour and keeping properties of the cream are problems of a bacteriological nature.
- 4) "Scalding" for 20 to 30 minutes with a final temperature of 187° F proved to be a satisfactory procedure.
- 5) One pound of clotted cream was produced from 23 pounds of milk.
- 6) The average percentage of butterfat in the clotted cream was 62 to 64 per cent.
- 7) The average butterfat content of the scald milk was 0.75 per cent.

912 — **Studies in Butter Shrinkage.** — GUTHRIE, E. S., in the *Journal of Dairy Science*, Vol. 1, No. 2, pp. 136-138. Baltimore, July, 1917.

The Dairy Division of the Cornell University has completed the storage studies of 100 tubs of butter. This butter was made in eight different churnings from sweet pasteurised cream. The body was good and the moisture was nicely incorporated. All the butter was overworked somewhat, which has a tendency to complete the incorporation of the water. The tubs were paraffined, and were weighed just before the butter was packed in them. The butter was weighed on November 20 after being in cold storage for 134 days at 6° to 10° F. The shrinkage or increase in weight was determined for each tub.

Seventeen packages showed an increase in weight ranging from 0.5 ounce to 27.5 ounces. Eighty three tubs showed shrinkage which varied from 0.5 ounce to 15.5 ounces. The total shrinkage was 377.5 ounces. The total increase of weight was 85 ounces. The net shrinkage was 292.5 ounces, or 18.28 pounds, which is 0.1828 pound for tub or 0.29 per cent.

913 — **The Relation of *Oidium lactis* and *Penicillium* to the Keeping Qualities of Butter.** — COMBS, W. B. and ECKLES, C. H., in the *Journal of Dairy Science*, Vol. 1, No. 3, pp. 347-355. Baltimore and London, November, 1917.

The primary object of the experiments reported in this paper was to determine the relation of *Oidium lactis* and a mould of the *Penicillium* group to the keeping qualities of butter, especially when these organisms had developed in the cream before churning. Only a portion of the data taken during the experiments is given, but the results were consistent and conclusive.

It was found that moulds do not grow readily upon butter, but their growth is influenced by the amount of protein, salt and moisture the butter contains and the moisture of the surrounding atmosphere.

The quality of cream as usually judged by taste is influenced to a marked degree by the growth of *Oidium lactis* and *P. Chrysogenum* when the cream is sweet, but no objectionable flavour can be detected in the cream as a result of mould growth when the cream is sour.

The growth of *Oidium lactis* or *Penicillium* upon cream exerts a decidedly detrimental effect upon the keeping qualities of the butter.

Mould spores do not germinate or make growth in butter. The growth of mould on butter is the result of a contamination from the outside.

Pasteurisation at ordinary temperatures greatly improves the keeping qualities of butter made from cream upon which moulds have made growth, but it does not entirely check the action of the enzymes which they produce. This action may be checked entirely by heating to a sufficiently high temperature but this point is beyond the limit of practicability for commercial use.

The abnormal flavours which develop in butter due to mould growth on the cream, are caused by enzymes which are secreted by the mould in the cream.

914 - **Varieties of Cheese: Descriptions and Analyses.** — DOANE, C. F. and LAWSON, H. W., in U. S. Department of Agriculture, Bulletin No. 608, pp. 80 + Bibliography of 103 publications. Washington, March 7, 1917.

This Bulletin gives descriptions of 287 different cheeses and analyses of 129 varieties extracted from the books and technical periodicals of the producing countries. The varieties are arranged in alphabetical order. It is pointed out that one type of cheese is frequently known under different names, thus making classification difficult.

915 - **Study on the Normal Production of Gas in Cheese: Investigations at the Agricultural Experiment Station of Hoorn, Netherlands.** — BOEKHOUT, F. W. and VRIES, J. J. OTT DE, in *Verhanden van Landbouwkundige Onderzoekingen de Rijkslandbouwschool* No. XXI, pp. 41-28 + 1 Plate. The Hague, 1917.

The authors undertook an investigation into the gas-producing organisms of cheese. As culture medium they employed that used by VON FREUDENREICH and JENSEN for the study of propionic fermentation in Emmenthal cheese. The constituents of this medium, which contains peptone and calcium lactate, are very similar to the nutritive matter of cheese which may be attacked by the organisms.

Samples of 4 to 5 weeks old Gouda and Edam cheese with many holes, were crushed with a physiological salt solution and put with VON FREUDENREICH's nutritive liquid into glass tubes, which were evacuated, sealed, and kept at 21° C. The tubes were opened and the contents used as inoculation material wherewith to repeat the operation. The final product was grown on gelatine.

1) **CHARACTERISTICS OF THE BACTERIUM.** — The authors succeeded several times in isolating the bacterium responsible for the production of gas in cheese. It is rod-shaped, 1.75 to 5  $\mu$  long and 1.2  $\mu$  broad. Milk is not a good culture medium. As a source of nitrogen the bacterium requires peptone, and calcium lactate as a source of carbon. The gas produced is a mixture of carbonic acid, hydrogen and nitrogen. Cultures

of this bacterium have very great vitality and contain living bacteria after 10 months. The optimum temperature is about 21° C.; a lower temperature, 10 to 12° C., greatly reduces development, and that of 55° C. is fatal.

2) INFLUENCE OF SALT AND LACTIC ACID. — The influence on the bacterium of varying quantities of salt and lactic acid added to the peptone and calcium lactate solution was then studied. The experiment was continued with the sealed tubes to which were added increasing quantities of salt and lactic acid. Including the salt already contained in the nutritive solution, the maximum quantity tolerated is 4.5 %; the maximum concentration of lactic acid is 0.3 %. When the lactic acid concentration is only 0.1 % a salt concentration of 4.5 % allows fermentation at the end of 21 days, and a concentration of 5.5 % at the end of 1 month.

3) REDUCING PROPERTIES. — The presence of hydrogen in the gas produced shows reducing properties. In the culture medium containing 0.03 to 0.05 % of nitrates there is reduction and transformation of the nitrates into nitrites, the final reduction of the latter being rather slow. If, however, the culture medium contains only nitrites they are completely reduced. (The same reduction phenomenon occurs with sodium nitrites and potassium chloride). Fermentation occurs only when the nitrates have been reduced, and this influence on the bacterium is the same in cheese as in culture media. Edam cheeses made with pasteurized milk were inoculated with the bacterium and 0.05 % of potassium nitrate; cheeses without nitrates were used as controls. In some of the cheeses there was no fermentation even after 10 or 20 days and the nitrates were still present. In those in which fermentation had taken place the nitrates had disappeared. Fermentation occurred in all the control cheeses (without nitrates).

As a rule, as soon as the bacterium has no more free nitrogen at its disposal it attacks the calcium lactate (formed in the cheese by the lactic fermentation). Carbonic acid and hydrogen are thus formed, causing cracks and holes in the cheese. The composition of the gases in the cheese is similar to that of the gases given off in the culture medium.

The authors were unable to isolate butyric ferments in the cheeses by this method and concluded that these ferments take no part in normal gas production and the formation of cracks.

916 — The Growth of Green Mould (*Penicillium glaucum*) for the Manufacture of Blue Cheeses. — CHAVASTELON, R., in *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol. IV, No. 18, pp. 564-566. Paris, May 22, 1916.

The author (Professor of general and agricultural Chemistry in the Faculty of Science at Clermont-Ferrand) describes a simple and practical method of growing *Penicillium glaucum*.

Bread is cut into slices 1 to 1.5 cm. thick, and soaked for about 10 minutes in a solution containing 35 to 37 gm. of tartaric acid per litre. The slices are then laid flat on frames made of reeds, about 5 to 6 mm. thick with a distance of 1 to 2 cm. between each, or, if need be, on straw mats; both must be previously scalded. The slices are sprinkled on both sides with green mould spores and the frames, which may be placed one

on the other, left in a damp place in which the air is always near its saturation point or, if speed is necessary, at a constant temperature of about 25° C.

If the damp condition is maintained fine cultures are obtained at the end of 16 days for temperatures of 14 to 18°, and at the end of 31 days if the temperature is about 8°. The production is maximum if the slices are turned over on the frames or mats once or twice during the period of culture so that all the parts are regularly aired.

To maintain the desired degree of moisture, in a simple installation, coarse sacking or matting, the ends of which are constantly in water, may be hung in the room.

The cultures are collected when the slices, which have become very thin, are uniformly green on both sides; this does not always occur. They are then dried in the air before being pulverised or passed through a mill. The fine powder, which only contains a very small proportion of the original bread, and, in the multitude of its spores, represents a very concentrated and almost pure culture, is kept in boxes.

If the operation is well carried out 20 lbs. of bread will suffice to sprinkle many thousand pounds of cheese.

917 - **Researches on the Physical and Chemical Constants of the Oily Matter of the Egg ("Eieröl").** — SCHÄFFER, F. and MEYER, L. (Laboratorium des Schweizerischen Gesundheitsamtes), in *Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene*, Vol. IX, Part 2 and 3, pp. 135-156 + 1 Table. Berne, 1918.

There is little available data regarding the physical and chemical constants of the oily matter of the egg, *i. e.*, the oils extracted from the yellow of the fowl's egg by means of solvents. Recent determinations carried out by L. MEYER in the laboratory of the "Service Suisse de l'hygiène publique" were made with fresh eggs and eggs that had been stored a long time, using chloroform and petroleum ether as solvents. The results are summarised in table form, from which it appears that:—

1) The nature of the solvent has a marked influence on the value of these constants, as was observed by JEAN (*Ann. Chim. analyt.*, 53, 1903); while petroleum ether only extracts the oily matter, chloroform extracts the cholesterin and a part of the lecithins as well.

2) The differences found for the refractive and iodine indexes vary, even for products that have been stored a long time, between the limits stated in publications on the subject. The results obtained for the iodine value, to which LAVES gives the value 64 as the minimum, show a considerable variation, however, being 74 to 75 on an average.

3) The phosphorus pentoxide content of the lecithins diminishes gradually during storage, being 1.27 % for the fresh egg and 0.8 % after storage for 2 years.

918 - **The Relative Influence of Microorganisms and Plant Enzymes on the Fermentation of Maize Silage.** — LAMB, A. R. (Iowa Agricultural Experiment Station), in *Journal of Agricultural Research*, Vol. VIII, No. 10, pp. 301-350, 9 Tables, + 13 Diagrams + Bibliography of 27 Publications. Washington, D. C., March 6, 1917.

The question of the respective causal relationship of micro-organisms and plant cell enzymes to the fermentation of maize silage has long been in

controversy. It is difficult to differentiate between the activities of these two kinds of agents. Work with antiseptics both by earlier investigators and by the writer is not conclusive. Experimental silage, other than antiseptic silage, has been made, with results of some value; but the most conclusive evidence was obtained by the determination of the rate of change in various phenomena of the fermentation under normal conditions. Curves plotted from these data show that bacteria are mainly responsible for acid production and the concomitant disappearance of sugars. Alcohol is formed first by plant enzymes and later by yeasts. Protein is hydrolysed first by enzymes and later by micro-organisms. Carbon dioxide evolution seems to be very largely due to respiratory or enzymic activities, but yeasts probably have a share in its production after the first day or two. Micro-organisms are probably largely responsible for the heating of the silage. Both kinds of factors are always present during silage fermentation and the process is due to the activities of both in the absence of air.

919 - **Changes in Composition of Sweet Potatoes left in the Ground when Mature.**

— See No. 851 of this Review.

920 - **The Influence of Salt on the Changes Taking Place in Storage Butter.** — WASHBURN, R. M. and DAHLBERG, A. C., in the *Journal of Dairy Science*, Vol. 1, No. 2, pp. 125-126. Baltimore, July, 1917.

It is generally believed, and most experimental evidence supports this belief, that salt improves the keeping quality of butter. It has been observed, on the other hand, that unsalted butter in commercial cold storage keeps as well as or better than salted butter.

The experiment reported in this paper deals with this point and considers only salted versus unsalted butter. The butter was first held for the usual cold storage period in a commercial cold storage butter room and was then held for a short time at the usual ice box temperature. This latter treatment is comparable to that which commercially stored butter would receive before being consumed. At each scoring the usual bacteriological and chemical analyses were made so that probable causes of a possible difference would not be overlooked.

*Making, Storing, and Scoring the Butter.* — The cream used was sweet, clean cream of good flavour. It was ripened without pasteurisation on the addition of a starter to an average acidity of 0.58 per cent lactic acid. It churned in 20 to 30 minutes; the churning was stopped at the wheat kernel stage; the butter was washed twice, salted or not, and worked from 23 to 27 revolutions in a Victor double roller churn. Half the butter of each churning was salted and worked and the other half worked unsalted so that each sample of unsalted butter had an exact duplicate in the salted butter. It was then packed into 5 pound paraffined wooden butter drums lined with parchment paper. Enough of these containers were packed so that one from each lot could be taken out at every scoring. Initial data as to score, chemical and bacteriological analysis were obtained. The butter was stored in a commercial butter storage room in St. Paul, at a temperature of  $-15^{\circ}$  F. After 284 days in cold storage it was held for twenty days in a butter-cutting room at  $58^{\circ}$  to  $60^{\circ}$  F.

The following points were studied:—Influence of salt on score; influence of salt on bacterial activity; influence of salt on acidity; influence of salt on moisture, protein content; relation of score, acidity and bacteria in salted and unsalted butter. The following facts were brought out:—

Salt, exclusive of its antiseptic property, hastened the deterioration of the butter.

When stored at  $-15^{\circ}$  F. unsalted butter kept as well as salted butter.

The bacteria in the unsalted butter decreased more rapidly at  $-15^{\circ}$  F. than they did in the salted butter and increased more rapidly at  $58^{\circ}$  F.

The acidity of the unsalted and the salted butter increased uniformly at  $-15^{\circ}$  F. but at  $58^{\circ}$  F the increase was greater in the unsalted butter.

Moisture was lost from the salted butter, but not from the unsalted kept at  $-15^{\circ}$  F.

Little if any relationship existed between the bacteria, the acidity, and the score in this butter.

## PLANT DISEASES

### DISEASES NOT DUE TO PARASITES OR OF UNKNOWN ORIGIN.

- 921 - "Fucha" of the Cotton Plant, in the Department of Boyacá, Republic of Colombia. — PESTICO, J. F., in the *Revista Agrícola*, Year IV, No. 2, pp. 113-116 + 1 Fig. Bogotá, 1918.

Towards the middle of 1917 in the comarca of Miraflores, an eastern province of the department of Boyacá, the cotton plantations were attacked by a disease commonly known as "fucha", which, by stopping growth, destroys the greater part of the produce.

The disease is characterised by numerous small swellings on the leaves and young branches and also, more rarely, on the flowers. It usually becomes visible after prolonged rain and the diseased plant fades and dies one or two weeks later. Occasionally the plant survives but gives no crop.

Growers in the comarca of Miraflores consider cotton as an almost wild plant requiring no attention. Without any previous preparation of the soil they sow and await the harvest.

According to the author it is the lack of cultural methods which causes the appearance of the disease in question, which can only be overcome by radically reforming the present methods and replacing the variety of cotton now grown by others from strong and healthy plantations.

The lack of weeding allows a multitude of bushes to grow up round the cotton plants. These receive the abundant rain and the sun, and cause the formation of a hot, damp atmosphere, favourable to the development of swellings. On the other hand, cotton under such conditions is weak and incapable of assimilating the elements supplied by the soil. Chlorosis of the young branches increases and growth in general is weak.

To avoid the decadence of cotton-growing in the above-mentioned district there is a crying need for deep and repeated ploughing seven weeks before sowing, for a careful selection of seed, continuous weeding etc. It is also necessary to regulate the date of sowing so that the wet season will coincide with the growth of the plants and the dry season with the ripening of the bolls.

- 922 - The Mottling of Citrus Leaves in Relation to their Composition. - See No. 1 of the *Review* for July, 1918.

- 923 - "Möistad Grenader", a Norwegian Variety of Oat Resistant to Lodging. See No. 855 of this *Review*.

- 924 - "Chasselas" × "Barlandieri 41 B" Vine Resistant to Bramble-leaf Disease.  
— See No. 873 of this Review.

## DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

- 925 - **Bacteria and Fungi Recorded as Parasitic on Cultivated Plants in the Province of Turin and Adjacent Regions in 1916** (1). — VOGELIO, P., in the *Annali della R. Accademia d'Agricoltura di Torino*, Vol. LX (1917), pp. 205-229. Turin, 1918.

In this phytopathological review 116 bacteria and fungi are recorded as being the most harmful to cultivated plants in the province of Turin and the adjacent regions during 1916. The most important are given below.

1) A bacteriosis of the dwarf bean observed in market gardens at S. Bernardino (Trana); on many of the plants with pods nearly 2 in. long, the terminal leaves and consequently all the young buds, withered in a few days, while the leaves that were well developed turned yellow or mottled red; in the tissues of both buds and leaves there were colonies of bacteria identical with those observed previously in market gardens at Trana; it is recommended that infested plants should be at once burnt.

2) Peach bacteriosis, observed in the orchards at Vezza d'Alba near Canale and characterized by yellowing of the leaves, drying-up of the branches and the death of the plant; according to the author these phenomena are due to the formation of woody tumours of various sizes on the root system; a bacterium corresponding to *Bacterium tumefaciens* has been isolated from the tubers; this disease, which the author thinks is identical with "crown gall", appears to be spreading alarmingly.

In order to help in the defence against vine mildew the Phytopathological Observatory of Turin founded, in 1916, a service of "preventive detection" by means of a number of observatory Stations. Although 1916 was, on the whole, unfavourable for the disease, the first year's results of this Service are very satisfactory and show its absolute necessity as regards the indication of the exact period when the first treatments must be carried out against the parasite.

- 926 - **Uredinales of the Andes. South America.** — ARTHUR, J. C., in *The Botanical Gazette*, Vol. LXV, No. 5, pp. 466-474. Chicago, May, 1918.

This paper enumerates 25 species all, with the exception of four, collected by Dr. and Mrs. Rose on a journey taken in 1914 through the west of South America, particularly Peru and Chile. The list includes some species new to science, and some rare ones. Special mention should be made of:—

1) *Colletesporium Senecionis* (Pers.) Fries, collected on various species of *Senecio* in different parts of Chile and La Paz, Bolivia. It is remarkable that this rust, which is very common in Europe, is also abundant in Chile and, apparently, also in Argentina, whereas it is practically unknown in

(1) See R., July, 1917, No. 680, (Ed.)



North America. The acidia occur on the leaves of pine. The fungus was collected at Providence, Rhode Island, in 1883 on *Senecio vulgaris*, but seems to have disappeared rapidly and was not reported again from any station in North America. No telia were found in any of the material examined. This shows that the acidia on pine are rare or absent in that district, and that the rust is chiefly or wholly reproduced by uredospores.

2) *Puccinia Malvacearum* Mont., on *Malva sylvestris* and *Malvastrum capitatum*, in different parts of Chile. It is one of the commonest and best known rusts which, from its native country, the Andes, has spread to all parts of the world where *Malvaceae* grow.

3) *P. Nicotianae* n. sp. on *Nicotiana tomentosa* at Santa Clara, Peru.

4) *Uredo Erythroxylonis* Graz., on *Erythroxylon Coca*, at La Paz; it is a common rust wherever this plant grows.

927 ***Nezara viridula* and Kernel Spot of Pecan.** — TURNER, W. F., in *Science*, New Series, Vol. XLVII, No. 1220, pp. 490-491, Lancaster, Pa., May 17, 1918.

In 1914 RAND described *Coniothyrium caryogenum* as a cause of the infectious disease known as kernel spot of pecan (*Carya olivaeformis*). It attacks the seed, causing the formation of irregular dark brown or black spots, which are usually rather sunken. The discolouration sometimes extends to the interior of the kernel, which becomes bitter.

The disease seems to exist wherever pecan is grown, although, as a rule, only a few of the kernels are attacked. Occasionally, however, as in 1916, it becomes of considerable economic importance, causing the loss of thousands of dollars to the growers.

*Nezara viridula* L. (1), commonly known as the green soldier bug, is found throughout middle and southern Georgia, where it occurs every year occasionally, as in 1916, becoming very abundant. This insect appears to attack cow peas in preference to all wild or cultivated plants. In autumn, when the cow pea begins to dry up, the bugs leave them for any other plants or trees near.

Pecan growers commonly sow cow peas in the plantation in early summer to use it later as green manure. When, in September or early October, the plant begins to dry up the insects pass from it to the pecans.

In 1916 a serious invasion of *N. viridula* was reported, coinciding with a severe outbreak of kernel spot. Although it is possible that it was a mere coincidence, many growers observed that the disease only appeared to be serious in the plantations where cow pea had been grown. Moreover, in at least one case, the insects were observed feeding on the pecan nuts.

Preliminary experiments were, therefore, made, in which specimens of *N. viridula* taken from cow pea were placed on green pecan nuts, on which they fed, living on them for a month in three cases. An examination of the ripe nuts showed all those in the cages used during the experiment to be seriously attacked by kernel spot, as many as five distinct spots being found on one kernel. Of several hundred nuts from the same tree not confined in cages only two or three had spots.

(1) See R. March, 1917, No. 293. (Ed.)

It has not yet been possible to determine whether *Coniothyrium caryogenum* is present in the spotted areas. In any case the data obtained point strongly to the fact that *N. viridula* is an important factor in producing or spreading the disease. This is of special interest because it is another of those observations, more and more frequent of recent years, of the economic importance of a large group of insects (several families of the Heteroptera, and, among the Homoptera, those of the *Cicadellidae* and *Aphididae*) as specific agents in various plant diseases, and as carriers and intermediaries in other diseases of bacterial or fungoid origin.

928 - **Selected Indian Wheats Resistant to Rust and Lodging.** — See No. 834 of this Review.

929 - **Patents for the Control of Diseases and Pests of Plants.** — See No. 899 of this Review.

930 - **Diseases and Pests of the Sweet Potato in the Philippines.** — See No. 864 of this Review.

931 - **Experiments on the Action of Polysulphide Against Oidium of the Vine.** — CAPUS, J., in *Revue de Viticulture*, Vol. XLVIII, No. 1251, pp. 393-394. Paris, 1918.

In 1917 the author made several experiments on the treatment of oidium with alkaline polysulphide, known commercially as "liver of sulphur", applied in quantities of 500 gm. per hectolitre of water with 500 gm. of soft soap. Oidium attacks were not serious in Gironde in 1917, and in only two of the six vineyards in which the experiments were made was it possible to obtain clear and interesting results.

At the Chateau of Issan, at Cantenac in Médoc, the first application of polysulphide was made on June 30. The adjacent rows of both sides were treated with sulphur on the same day. The second application was on July 21. The adjacent rows were treated twice more with sulphur. The two polysulphide applications gave a protection as efficient as that of the three sulphur ones.

At Saint-Emilion, at Lamarzelle Chateau, two polysulphide treatments gave the same results as two sulphur treatments. This vineyard was infested with *Polychrosis botrana* which did much damage there in 1917. Polysulphide was applied for the second time during the first fortnight of July, at the time of the flight of the moths. On the clusters treated with polysulphide there were only half as many larvae as on those sprayed with sulphur.

In another experiment carried out at Saint-Sornin (Charente-Inférieure) lime-sulphur spray mixed with Bordeaux mixture was tried instead of polysulphide against oidium and mildew. The first results were satisfactory and the author intends continuing the experiment in 1918.

From a theoretical point of view alkaline polysulphide controls oidium. From a practical point of view, however, sulphur will always be preferred because:— 1) sulphur is always ready for use, whereas polysulphide must be dissolved; 2) sulphur is a fine powder and scatters more easily, penetrating better to the organ to be protected, i. e., the fruit, than a liquid, especially in summer when the clusters are hidden by the leaves; 3) polysulphide may

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injure the spraying machines, which are usually of copper, and must be carefully washed with fresh water after use.

Should the vine-grower have only an insufficient amount of sulphur he may use polysulphide only for the first treatments, to made before flowering. During this period it would have the following advantages:— 1) as the young bunches are not yet hidden by the leaves the liquid reaches them more easily; 2) at this time of year the temperature is not always sufficiently high to make the sulphur active; 3) as attacks of oidium have not yet begun the treatment is preventative; the sulphur being a powder, does not remain long on the leaves and is active only for a short time; 4) polysulphide may be applied at the same time as sulphur. More complete experiments will show whether, under these conditions, copper mixture is equally efficacious against mildew.

#### WEEDS AND PARASITIC FLOWERING PLANTS.

- 932 — **Mexican Marigold (*Tagetes minuta*), a Weed in Rhodesia.** — EYLES, F., in *The Rhodesia Agricultural Journal*, Vol. XV, No. 2, pp. 153-154 + 2 Plates. Salisbury, Rhodesia, April, 1918.

In recent years Rhodesia has been invaded by a troublesome weed, *Tagetes minuta* L. (Compositae). It is generally known as Mexican Marigold, but is locally called Mexican Poppy, and, in Australia, Stinking Roger. It is a native of South America and believed to have been introduced into South Africa during the Boer War.

At the present time it is spreading with great rapidity in Rhodesia, both in waste and cultivated land and shows a marked preference for ant hills. Its root system is shallow and not very extensive, and it should be possible to destroy the plant or prevent its spreading. It succumbs to the usual methods of cultivation, but if its spread is to be checked it must be uprooted and killed while young, *i.e.*, before flowering, so that seed may not be formed.

The author has recently heard some farmers call this plant "Khaki Weed", which is an entirely different plant, *Alternanthera echinata* (fam. *Amarantaceae*), known in Rhodesia long before the Mexican Marigold first appeared. The confusion is probably caused by the fact that the Dutch call the Compositae, "Khakibos".

#### INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

- 933 — ***Aleyrodidae* Injurious to Various Plants in Different Countries (1).** — QUAINANCE, A. J., and BAKER, A. C., in *Proceedings of the U. S. National Museum*, Vol. LII, No. 2156, pp. 335-445 + 10 Figs. + 46 Plates. Washington, 1917.

This paper is a continuation of the author's work on the classification of the *Aleyrodidae* based on material in the collections of the United States National Museum and the Bureau of Entomology, Washington.

(1) *S.c. R. Nov.*, 1916, No. 1241 (*Ed.*).

The following insects are described morphologically :—

- 1) *Aleurocanthus bambusae* (Peal), abundant on various species of *Bambusa* near Calcutta. Generally only a few leaves of a group of plants are attacked by the insect, but nevertheless it has been found in very large numbers in some bamboo clumps; in such cases it is a rather serious pest and often kills most of the leaves. The insect is controlled by a parasite, probably a chalcidid. When the insect is removed from the leaf the part beneath it is found to be yellow and discoloured.
- 2) *A. banksiae* (Muskell), living on *Banksia integrifolia* and *Collistemon linearis*, in Australia;
- 3) *A. calophylli* (Kotinsky), on *Calophyllum neophyllum*, at Levuka, (Fiji);
- 4) *A. citricolus* (Newstead), on *Citrus* sp., at Dares Salaam, German West Africa;
- 5) *A. citriperdus* Quaintance and Baker, on orange and an unknown tree in Java, Ceylon and India; apparently an abundant species;
- 6) *A. dissimilis* n. sp., on unknown vine, at Mirdon, Lower Burma;
- 7) *A. hirsutus* (Muskell), on *Acacia longifolia*, in Australia;
- 8) *A. longispinus* n. sp., on *Bambusa*, at Calcutta and Maulmein, Burma;
- 9) *A. mangiferae* n. sp., on mango, at Bombay, Saharanpur and Dehra Dun, India;
- 10) *A. nubilans* (Buckton), on leaves of *Piper Bette*, at Backergunge, India, where it did considerable damage;
- 11) *A. piperis* (Muskell), on *Piper nigrum* (?), in Ceylon;
- 12) *A. serratus* n. sp., on an unknown tree in the Botanical Gardens of Brittenberg, Java;
- 13) *A. spiniferus* (Quaintance), on *Citrus* sp. and rose, at Garct, Java;
- 14) *A. spinosus* (Kuwana), on unknown host; found by KUWANA among Coccidae from Formosa;
- 15) *A. T-sinensis* (Muskell), on *Acacia longifolia* near Sydney, Australia;
- 16) *A. woglumi* Ashby, a very common species in the east, recently introduced into the West Indies and Bahama Islands;
- 17) *A. voltschovi* (Newstead), on unnamed plant, the leaves of which were almost entirely covered with the black puparia, larvae and eggs of the insect, at Sainte-Marie, Madagascar;
- 18) *Aleurocybotus graminicolus* (Quaintance);
- 19) *A. setiferus* n. sp., on *Imperata*, at Java, and on grass, at Peradeniya, Ceylon;
- 20) *Aleurolobus borodensis* (Muskell), on *Saccharum officinale*, at Baroda, India; reported as injurious;
- 21) *A. flavus* n. sp., on unknown tree in the Royal Botanic Gardens, Ceylon and on *Eucalyptus*, at Peradeniya;
- 22) *A. maritimi* (Quaintance), on orange, at Hikato and Kamaoto, Japan;
- 23) *A. olivinus* (Silvestri), on olive in central and southern Italy;
- 24) *A. philippinensis* n. sp., on unknown tree and on *Murraya exoniata*, at Manila, Philippines;
- 25) *A. solitarius* n. sp., on *Harpullia pendula* and on unknown host, at Peradeniya;
- 26) *A. simulus* (Peal), very abundant on *Bombax malebaricum* (Simul tree) in Calcutta: the leaves are thickly covered with the insect, become yellow or spotted where attacked and finally die;
- 27) *A. solitarius* n. sp., on *Cercis canadensis*, at Champaign, Illinois;
- 28) *A. taenabae* (Kuwana), on grapes at Okoga and on grapes and *Taenabo japonica* at Tokio;
- 29) *Aleuroparadoxus iridescens* (Bemis), on *Arctostaphylos* sp., near Camp Rincon, San Gabriel Mountains, California;
- 30) *A. punctatus* n. sp., on *Lithraea caustica* and *Quillaja Saponaria*, at Santiago, Chile;
- 31) *Aleuropatus* (subgen. *Aleuropatus*) *berbericolus* n. sp., on *Berberis Aquifolium*,

at Kaslo, British Columbia; the insect was also collected at Mexico City and on *Ilex*, at Toluca, Mexico;

32) *A. (Aleuroplatus) cockerelli* (Jhering);

33) *A. (Aleuroplatus) coccolus* n. sp., on coconut at Santiago de las Vegas, Cuba, and in Trinidad; on *Eugenia Micheltii*, at Ceara, Brazil; has also been found in Panama;

34) *A. (Aleuroplatus) coronatus* (Quaintance), on *Quercus agrifolia*, in Los Angeles, Pomona and Whittier, California, on unknown plant in San Bernardino, Calif., and on chestnut in Pasadena, California;

35) *A. curvæ* (Kuwana);

36) *A. (Aleuroplatus) ficus-rugosæ* n. sp., on *Ficus rugosa*, in the Royal Botanic Gardens of Calcutta;

37) *A. (Aleuroplatus) gelatinosus* (Cockerell);

38) *A. (Aleuroplatus) incisus* n. sp., on *Ostodes zeylanica*, *Garcinia spectabilis* and on an unknown tree in the Royal Botanical Gardens, Peradeniya;

39) *A. (Aleuroplatus) myricæ* n. sp., on *Myrica* sp. (?), at Griffin, Georgia;

40) *A. (Aleuroplatus) oculiminutus* n. sp., on *Ficus* sp., in Trinidad;

41) *A. (Aleuroplatus) oculitreniformis* n. sp., on *Passiflora*, at Ceara, Brazil;

42) *A. (Aleuroplatus) ovalis* n. sp., on *Berberis trifoliata*, at College Station, Texas;

43) *A. (Aleuroplatus) pectiniferus* n. sp., on *Morus* sp. and a Euphorbiaceæ, at Lahore, India;

44) *A. (Aleuroplatus) plumosus* (Quaintance); was described from Florida; very abundant on cranberries, and collected on this plant at Craunmoor, Wisconsin, New-Egypt and Pemberton, New Jersey;

45) *A. (Aleuroplatus) quercus-aquaticæ* (Quaintance);

46) *A. (Aleuroplatus) sculpturatus* n. sp., on *Heliconia*, Panama;

47) *A. (Aleuroplatus) translucidus* n. sp., on orange at Lahore and Wazirabad, India;

48) *A. (Aleuroplatus) validus* n. sp., on unknown host, at Hope, Kingston, Jamaica;

49) *A. (Aleuroplatus) variegatus* n. sp., on leaves of *Peidium* sp., at San José, Costa Rica;

50) *A. (Aleuroplatus) vinsonioides* (Cockerell), on *Nectandra*, at Matanzas, Cuba;

51) *A. (subgen. Orchamas) mammatiferus* n. sp., on *Codiaeum variegatum*, in the Botanical Gardens at Buitenzorg;

52) *Aleurothrixus* (subgen. *Aleurothrixus*) *azbim* (Goeldi), on *Manihot utilissima*, at Rio de Janeiro;

53) *A. (Aleurothrixus) flavus* (Maskell); this species was described for the first time on lignumvitæ from Jamaica, and later on guava from Brazil; it was reported on orange at Zapotlan, Mexico, but had previously been collected on the same plant at Laguna, Mexico; it is common in the West Indies, and is also found in Florida, British Guiana, Argentina, Chile, Paraguay, and Costa Rica; besides *Citrus* spp. it has been found on *Coccoloba uvifera* (sea grape), *Plumaria* sp., *Baccharis gonistelloides*, a coarse grass, and a climbing vine;

54) *A. (Aleurothrixus) howardi* (Quaintance), on the same hosts and in the same localities as the preceding species; reported for the first time in the United States on sea grape at Miami, Florida;

55) *A. (Aleurothrixus) porteri* (Quaintance and Baker), common on citrus in Chile;

56) *A. (subgen. Philodamus) interrogationis* (Benis);

57) *Dialeurodes* (subgen. *Dialeurodes*) *citræ* (Ashmead), known as the orange white fly, is found on orange in the following States of the United States: Alabama, California, Colorado, Florida, Illinois, Louisiana, Mississippi, North Carolina, Texas, and District of Columbia; specimens have also been received from India (Lahore, Gujranwala, Dehra Dun, Wazirabad, Amritsar, Khasia Hills, Assam, Saharanpur), Japan (Nagasaki), and China (Canton, Peking, Shanghai); the insect also occurs in Chile, Mexico, and Brazil;

58) *D. (Dialeurodes) citrifolia* (Morgan) on orange in the following States: — Florida.

California, Louisiana, Mississippi, and North Carolina; the species is also known from Mexico and Cuba;

- 59) *D. (Dialeurodes) fodsens* (Maskell), on *Drimys axillaris*, in New Zealand;
- 60) *D. (Dialeurodes) kirikaldyi* (Kotinsky), on leaves of *Jasminum* at Georgetown, Demerara, British Guiana;
- 61) *D. (Dialeurodes) radiipuncta* n. sp., in Ceylon;
- 62) *D. (Dialeurodes) tricolor* n. sp., on leaves of a myrtaceous plant at Eubato, Brazil;
- 63) *D.* (subgen. *Rusostigma*) *eugeniae* (Maskell), on *Eugenia Jambolani*, in India;
- 64) *D. (Rusostigma) radiirugosa* n. sp., on mango, in Brilliton 1-le, Dutch East Indies and on a woody shrub at Gerit, Java;
- 65) *D. (Rusostigma) tokyonis* (Kuwana), on *Ilex integra*, in the locality Shibuya, Tokyo;
- 66) *D.* (subgen. *Dialeuronomada*) *dissonans* n. sp., on *Phyllanthus myrsinifolius* at Sahampur, India;
- 67) *D.* (subgen. *Rabdosstigma*) *radistencalis* n. sp., on mistletoe, at New Ava Eliya, Ceylon;
- 68) *D.* (subgen. *Gigaleurodes*) *cerifera* n. sp., on *Celastrus bursifolius*, at Cape Town, South Africa;
- 69) *D. (Gigaleurodes) basckii* n. sp., on leaves of a climbing vine, at Bayamon, Porto Rico;
- 70) *D. (Gigaleurodes) maxima* n. sp., on *Ficus* sp., at Manila, Philippines;
- 71) *D. (Gigaleurodes) struthanthi* (Hempell), on *Struthanthus flexicaules*, orange *Michilia flava* and unidentified forest tree at Parahyba and São Paulo, Brazil;
- 72) *S.* (subgen. *Rachisphora*) *fijensis* (Kotinsky), on leaves and fruit of a Leguminosae at Rewa, Fiji;
- 73) *D. (Rachisphora) rutherfordi* n. sp., on *Loranthus*, at Peradeniya, Ceylon;
- 74) *D. (Rachisphora) trilobitoides* n. sp., on *Harpullia* and *Eugenia oeculata*, at Peradeniya, on an unknown plant in the Royal Botanical Gardens, Ceylon;
- 75) *S.* (subgen. *Dialcurophora*) *decempuncta* n. sp., on *Cinnamomum*, in the Royal Botanical Gardens, Ceylon, and on mulberry, at Lahore, India;
- 76) *D.* (subgen. *Dialcuroplata*) *leucosticta* n. sp., on a fern at Jacana, Tayabas, Philippines;
- 77) *Neomaskellia comata* (Maskell);
- 78) *N. bergii* (Signoret), on unknown host in Java, and on a wild grass at Manila.

934 - West Indian and North American Chalcids. — GIRAULT, A. A., in *Entomological News*, Vol. XXIX, No. 1, pp. 125-131. Philadelphia, April, 1918.

The following should be noted:—

- 1) *Grotiasomyia nigricans* (Howard); one female reared from a larva of *Eudamus proteus* in St. Vincent, British West Indies.
- 2) *Gr. flavicornis* Girault; two females reared from a pyralid leaf-miner on oat at Washington, D. C.
- 3) *Polycystus clypeatus* n. sp.; one female reared from a leaf-miner on maize in St. Vincent.
- 4) *Sycophila inverta* Ashmead; many females reared from *Ficus laurina*, Barbados, West Indies.
- 5) *Indarnes carme* Walker, reared with a *Blastophaga* from *F. laurina* in Barbados.
- 6) *Pseudomphale eudami* n. sp.; reared from the larva of *Eudamus proteus* in St. Vincent.
- 7) *Closterocerus utahensis* Crawford (*Cl. californicus* Girault); one female from *Symydobius chrysolepis*, on *Quercus chrysolepis*, in California.
- 8) *Omphalchrysocharis petiolatus* n. sp.; reared from an oscinid on a daisy, at Washington, D. C.

9) *Arthrolytus aeneoviridis* Girault; one female from *Bucculatrix thurberiaella*, on cotton at Phoenix, Arizona.

935 - *Ipobracon saccharalis* n. sp. and *Microdus diatraeae*, Hymenoptera Parasitic on *Diatraea saccharalis*, a Microlepidopteron Injurious to Sugar Canes, in British Guiana. — TURNER, R. E., in the *Bulletin of Entomological Research*, Vol. IX, Pt. 1, pp. 81-82. London, May, 1918.

Three species of Braconidae have been bred in British Guiana from the larva of *Diatraea saccharalis* (1):—

1) *Ipobracon grenadensis* Ashm., previously mentioned by the author (1917);

2) *I. saccharalis* n. sp., a parasite of the larva of *Diatraea*, in the Non Pareil Plantation, East Coast of Demerara;

3) *Microdus diatraeae* n. sp., a parasite of the larva of the same microlepidopteron, at Lusignan, Non Pareil and Ogle plantations, East Coast of Demerara.

A morphological description of both of these two last species is given.

936 - Weevils Which Affect the Potato, Sweet Potato, and Yam. — PIERCE, W. D., in the *Journal of Agricultural Research*, Vol. XII, No. 9, pp. 601-612 + 7 Plates. Washington, March 4, 1918.

In 1914 the author reported three weevils observed in South America as important pests of the potato tuber. In the paper under review he enumerates the three weevils previously studied, describes a fourth which also attacks the potato, gives notes on the morphology of four other weevils injurious to sweet potato (*Ipomoea Batatas*) tubers and of another described as a new pest of tubers of the yam (*Dioscorea Batatas*).

WEEVILS WHICH ATTACK IRISH POTATO TUBERS: — 1) *Rhigopsidius tucumanus* Heller, reported by the author in 1914 in the following localities: Tucumán, Argentina; Cuzco, Temuco, and Arequipa, Peru; Oruro, Bolivia; Aneud or San Carlos and Castro Islands, Chile.

2) *Premnotrypes solani* Pierce (1914) in the mountain districts of Peru.

3) *Trypopermnon latithorax* Pierce (1914), described as a pest of tubers from Cuzco; on June 11, 1914, Mr. H. L. SANFORD found numerous larvae of this species in potatoes from La Paz, Bolivia; the transformation of the larvae into pupae was noticed from June 20 to 26, and an adult emerged on June 26; this enabled the author to describe the larva and pupa.

4) *Tryp. sanfordi* n. sp., described from a single specimen collected by Mr. SANFORD on September 24, 1915, from a potato from Cuzco.

WEEVILS WHICH ATTACK SWEET POTATO TUBERS (2). — 1) *Cylas formicarius* Fabricius var. *elegantulus* Summers; the author gives this name temporarily to the common sweet potato weevil with bluish elytra, red thorax and legs, and black head; the larva and pupa are described from specimens taken at Victoria, Texas; the figures of the male are drawn

(1) See R. April, 1916, No. 475 (Ed.) — (2) See R., May, 1918, No. 607. (Ed.)

partly from a New Orleans, Louisiana, specimen, partly from a Honolulu, Hawaiian Islands, one; specimens found at Victoria were used for the figures of the larva and pupa.

2) *C. turcipennis* Boheman; two specimens from Palembang, Sumatra, and two from Bay Laguna Province, Philippine Islands, are considered as belonging to this species; an adult was found in Guatemala; the insect was observed by PASCOE at Sarawak, Java and in India.

3) *C. femoralis* Faust; collected from February to April, 1897, on Mount Coffee, Liberia, where it did serious damage; it has also been reported from Kamerun.

4) *Euscepes batatae* C. O. Waterhouse (Scarabee of the Sweet Potato); one of the most serious cosmopolitan pests of the sweet potato, though up to the present it has only been reported from Barbados, St. Vincent, Antigua, St. Kitts, Nevis and Hawaii; having received from Brazil two specimens of this weevil with the statement that they attacked sweet potatoes at Rio de Janeiro, the author undertook research through the undetermined collections of the U. S. National Museum and was thus able to ascertain the existence of the insect in Barbados, Jamaica (Hope, Kingston), Brazil (Campinas, Rio de Janeiro), Hawaii (Honolulu, Kaimuki, Oahu), Guam, Norfolk Island near New Zealand, and Porto Rico (Mayaguez); the wide geographical distribution of the insect makes it appear probable that it is found in many other districts where the sweet potato is grown; a description of the adult, larva and pupa is given; material from Hawaii has been used for the figures of the adult, material from Barbados for those of the larva and pupa.

WEEVIL WHICH ATTACKS THE YAM TUBER. — *Palaeopus dioscoreae* n. sp.; described from two specimens reared from the tubers of yams from Jamaica (Hope, Kingston).

937 — *Physothrips marshalli* n. sp., a Thrips Observed on Potato and Other Plants in the Gold Coast. — BAGNAL, R. S., in the *Bulletin of Entomological Research*, Vol. IX, Pt. 1, pp. 65-70 + 3 Figs. London, May, 1918.

The author describes particularly as a species new to science under the name of *Physothrips marshalli* a thrips collected at Aburi, Gold Coast, where it appears to be common.

Females only were found in flowers of *Solanum tuberosum* and *S. Wendlandii*; both sexes, but chiefly females, in flowers of *Ipomoeae Bona-nex*; both sexes with fairly plentiful males, in flowers of *Hibiscus sinensis*, *Thunbergia erecta*, *T. laurifolia*, *Strophanthus gratus* and *Canna*.

Morphological notes are also given on two previously described species, *Phys. funtuniae* Bagn. (1913), and *Phys. kellyanus* Bagn. (1916), the first of which forms the type of a small group of the genus *Physothrips* which includes the two species mentioned above.

*Phys. funtuniae* lives on *Funtumia elastica* and is known in Uganda and Southern Nigeria. *Phys. kellyanus* was described from specimens collected in North Queensland on a composite plant (*Helianthus* sp.?), and on a South African plant (*Acopanthus spectabilis*) in the Botanic Gardens of



Brisbane, Queensland. The insect has also been found in Victoria on *Hy-pochoeris radicata*.

938 - **Damage Caused to the Cotton Plant in Algeria by *Gelechia gossypiella*.** - See No. 865 of this Review.

939 - **The Sugar-Cane Frog hopper in Grenada, Lesser Antilles.** - WILLIAMS, C. B., in the *Bulletin of Entomological Research*, Vol. IX, Pt. 1, pp. 83-87 + Map. London, May, 1918.

During investigations carried out on behalf of the Government of Trinidad on frog hoppers (*Cercopidae*) of the genus *Tomaspis* found on sugar cane in that and the neighbouring islands (1), the author stayed a few days in December, 1916, at Grenada to study a small but serious attack of frog hoppers there.

The insects were first reported from Grenada by UHLER in 1895, under the name of *T. pictipennis* Stål. In 1912 several specimens found on Para grass (*Panicum barbinode*) were sent from Grenada to the Board of Agriculture at Trinidad. URICH believed these to belong to the same species as that recorded by UHLER; it was, however, not *T. pictipennis*, but a species very similar to that of Trinidad, *T. saccharina* Distant, then known as *T. varia* Fabr. Urich nevertheless believed the Grenada specimens to be distinct from the Trinidad species. At the beginning of December, 1916, frog hoppers were reported to be doing serious damage to sugar cane in one part of Grenada.

Frog hoppers of one species were found widely distributed in the Island on grass in cane-fields, on the roadside, and also on sugar cane. The author did not visit the north-east of the Island, but it is probable that frog hoppers are there too. Their wide distribution shows that they have long been established at Grenada.

The damage was reported from Mount Horne and Nainganfoix. The author visited the first locality and found the principal characteristics of the frog hopper attack were quite similar to those found in Trinidad.

A careful comparison of the numerous specimens of the insect found in Grenada and the Trinidad species led the author to conclude that in both cases the insect was *T. saccharina* Distant. This is the first certain record of this insect outside Trinidad.

With regard to the natural enemies of the hemipteron (2), no larvae of the Trinidad Syrphid fly (*Salpingogaster nigra*) (3) were found at Grenada, and if present they must be too rare to have any effect in the control of the insect.

A single dead adult frog hopper was found to be infected with *Metarhizium Anisopliae* (4), but this is also too rare to be of any practical use.

(1) See *B.* Dec., 1910, p. 421; *B.* Jan., 1911, No. 352; *B.* Feb. 1911, No. 649; *B.* May, 1911, Nos. 1558 and 1584; *B.* Dec., 1912, No. 1698; *B.* June, 1914, No. 549. (Ed.) -

(2) See *B.* Nov., 1910, p. 186; *B.* Feb., 1911, No. 650; *B.* Dec., 1912, No. 1698; *B.* Nov., 1913, No. 1306; *B.* Feb., 1914, No. 188. (Ed.) - (3) See *B.* Feb., 1914, No. 188. (Ed.) -

(4) See *B.* Feb., 1911, No. 650; *B.* Dec., 1912, No. 1698. (Ed.)

Attid spiders, an important control in Trinidad, were very scarce on the canes at Grenada.

Some specimens of the predatory grasshopper (*Xiphidium fasciatum*) known to feed on froghoppers were found in the grass near infested cane fields as well as in other parts of Grenada. It does not, however, appear actually to enter the plantations, but may help to keep down the froghoppers in the areas between, and so prevent a rapid spread of the insect.

The mongoose (mammal belonging to the genus *Herpestes*), which is indirectly partly responsible for the damage done by the insects because of the birds and lizards it destroys, is generally common in Grenada, and in some localities rewards are offered for its destruction.

The author spread over the infested fields in Grenada a mixture, prepared at Trinidad, composed of artificial cultures of *Metarrhizium* spores and rice flour, in the hope of infecting the froghoppers. After leaving Grenada he was informed that several dead infected grasshoppers were observed at Mount Horne, and that in 1917 the insects again appeared in the fields he had visited, but not to the same extent as in the previous year.

*T. saccharina* was found in the following localities of Grenada: St. George, Belmont, on grass among cane; Morne Rouge, on cane; St. George Lower Road, on grass; Woodlands and Calvini, on cane; St. Davids; North of Barley's Bacolet, on grass; La Sagesse, on grass; St. Andrew, Mereve, Simon, St. Andrew Harbour, on grass; Lower Simon, Mount Horne, Nain-ganfoix, on cane; St. Patrick; St. Mark and St. John were not visited by the author, but there is no doubt that the insect also exists there.

940 - **Hemiptera Living on Cultivated Plants in the Belgian Congo.** — DISTANT, W. L., in the *Bulletin of Entomological Research*, Vol. IX, Pt. 1, pp. 71-73 + 3 Figs. London, May, 1918.

The author describes the following species of hemiptera (fem. *Capsidae*):—

- 1) *Lycidocoris mimeticus* Reut. and Popp.: Var. A. (typical form) was found at Lubowa, Uganda; Var. B. was found on coffee bushes at Eala, Belgian Congo;
- 2) *Lyc. modestus* n. sp., on *Cinchona*, at Eala;
- 3) *Lyc. thoracicus* n. sp., on indigenous rubiaceous plant, at Eala;
- 4) *Chamus bellus* n. sp., on "lionzi" at Eala;
- 5) *Ch. tuberculatus* n. sp., on *Psidium Guajava* at Kunnulu, Belgian Congo.

941 - ***Physothrips setiventris* n. sp. and *Phys. lefroyi*, Thrips Injurious to Tea in India.** — BAGNALL, R. S., in the *Bulletin of Entomological Research*, Vol. IX, Pt. 1, pp. 61-64 + 2 Figs. London, May, 1918.

A description is given of the two following species found in India on tea in such numbers that they may be regarded as pests:—

- 1) *Physothrips setiventris* n. sp., collected on tea at Ringon, T. E., Darjiling district, in June, 1916; females were taken on the same host plant at Lebong, in September, 1908;
- 2) *Phys. lefroyi* Bagnall, observed on flowers of tea at Lebong, in February, 1909.

942 - Pests Observed on Tobacco from Réunion Grown in Mauritius. — AUCHINCLOSS, G. G., in *Department of Agriculture, Mauritius, General Series, Bulletin No. 9*, pp. 6. Port Louis, 1917.

In 1916 to 1917 cultural experiments were made in Mauritius with a variety of tobacco widely grown in the neighbouring island of Réunion under the name of "tabac bleu". Its produce (scaferlati) is imported into Mauritius in large quantities and is largely consumed there. The experiments gave good results, but the plant suffered from insect and fungoid pests.

In the first stages of development the plants on the borders of the plot cultivated at Pamplémousses were seriously attacked by *Achatina ponderosa*. The molluscs were collected by hand and destroyed. To keep the pest away till the tobacco-plants were sufficiently strong lime was spread around them.

The young plants were slightly damaged by larvae of *Heliothis armigera*, which was controlled by collecting it by hand.

Young seedlings are subject to attack from *Pythium de Baryanum* if planted too close. This may be prevented by spreading ashes round the seedlings and thinning out the young plants.

Ants are particularly fond of the seeds. To protect the seedlings against these insects they should be surrounded by a border of earth moistened with paraffin.

The most serious damage was due to a disease of the roots, an anguillulid (*Heterodera*), and a fungus producing spots on the leaves. Steps must be taken in the future to control all these three causes of disease. The disease of the roots, probably due to a *Fusarium*, invaded the small plantation at Beau Bassin. Several plants were killed by the fungus, which, it seems, may be controlled by spreading lime abundantly over the soil and by isolating the infected plot by a trench.

The anguillulid appeared in the Pamplémousses plantation and in a small plot at Réduit. The growth of the plants attacked was arrested, and they turned pale and sickly looking. Some parts of Mauritius seem seriously infested by this worm, and it is doubtful whether tobacco could do well there.

The spots on the leaves are caused by a fungus (*Erysiphe*). Small, round, reddish-brown spots occur on the mature leaves. At Pamplémousses in 1915 the Turkish tobacco suffered severely from this disease, many of the plants being quite unusable. The "tabac bleu" variety remained immune till the plants were fully ripe, and was then attacked, but only slightly. In a wet year, however, the damage might be very serious seeing that badly spotted leaves reduce the value of the tobacco. Moreover, in the case of tobacco, a disease of the leaves is very difficult to treat because anti-cryptogamic sprays would injure the quality of leaves to be used for smoking.

943 - *Agriolimax agrestis*. A Molluscan Garden Pest, in New York State. — BAKER, F. C., in *Science*, New Series, Vol. XLVII, No. 1216, pp. 391-392. Lancaster, Pa., April 19, 1918.

The author previously reported the presence of this slug in market gardens in New York State, where it had done considerable damage to

cauliflowers, lettuces, and potatoes (1). In the summer and early autumn of 1917 the slug became still more troublesome.

At Brewerton it was observed eating cabbages and potatoes; in Syracuse it attacked potatoes, doing much injury in several fields and gardens. In one garden potatoes were so severely attacked that two-thirds of the tubers were destroyed. Several slugs were found in a single potato together with many larvae of a beetle (probably *Agriolus manicus* Say) and isopods. The larvae of the coleopteron were reported as very abundant in potatoes in Syracuse and Rochester, and damage by the slug was reported from Rochester, Canandaigua and Geneva.

It is obvious that the slug is becoming a pest in market gardens and that it must be controlled; when its action is limited to the epigeal parts of the plant this may be done by spreading fine ash round the plant; the copious flow of mucus caused by the irritating action of the ash exhausts the slug. This method, however, is not effective if the soil is penetrated and the tuber attacked below the surface. If the grass round the garden were kept short it would not be possible for the slug to hide there during the day, for it is only active at night. Boards placed round the garden may also be used as traps; during the day the slugs hide under them and may be collected and killed.

*A. agrestis* is one of the most common slugs in western New York.

It is interesting to note that a related species, *A. campestris* Binney, as been observed eating considerable numbers of plant lice (*Phorodon vahaleb* Fouse.); thus, unlike *A. agrestis*, this is a useful species.

44 - *Stephanitis rhododendri*, (Injurious to Rhododendrons, in France. — MARCHAL, P. in the *Bulletin de la Société de Pathologie végétale de France*, Vol. IV, Pt. 2, pp. 93-95. Paris, 1917.

The presence of a new pest of ornamental trees was observed in the neighbourhood of Paris in 1917. The pest, a hemipteron of the Tingidae family (Hemiptera-Heteroptera), *Stephanitis rhododendri* Horv., was discovered in nurseries at Châtenay (Seine) and has since been observed at Versailles.

According to information from Versailles the insect was introduced in rhododendron trees imported from Holland tree or four years ago. It was in Holland, in the Boskoop nurseries, that *Steph. rhododendri* was first observed, and HORVATH described it in 1905 from samples collected here. In spite of all attempts to destroy it the insect has persisted in this locality and spread into the neighbouring district. In 1910 it was also reported from England by DISTANT, who believes it to have been introduced into Europe from the Indies, though the name by which it is known in Holland, "japansche luik", implies that it might have been imported from Japan.

The damage done by *Steph. rhododendri*, chiefly in June and July, is similar to that done by *Steph. pyri* Fabr. Certain varieties of rhododendron suffer much more than others. According to RITZEMA BOS the eggs are

(1) See B. May, 1916, No. 600. (Ed.)

laid towards the end of July or the beginning of August on the thick part of the under surface of the leaf, near the main vein. The eggs hibernate and hatch in spring. After three months the wings of the insect are fully developed, thus enabling it to emigrate to other plants. In Holland at least there is only one generation a year.

The best means of controlling the insect is by spraying with nicotine soap, or pyrethrum, which must be applied so as to reach the under surface of the leaf. The soil must be turned with a spade after the treatment, which should be applied frequently early in spring, before the wings of the insect have developed. In Holland "X. L. All." insecticide is most used, or else a nicotine solution mixed with 2 % soap and 1 % spirit.

Fumigations with tobacco under a cloth arranged as a tent may also be recommended. Where there is a staff accustomed to fumigation with hydrocyanic acid there is little doubt that this method would give the best results.

To prevent the spreading of the insect, care must be taken to use only healthy plants as stock and to examine young plants when transplanting them, carefully picking and burning all leaves attacked by the insect.

945 - *Cecidomyid Flies Living on *Olea chrysophylla* and *O. europaea*, in Eritrea and Italy Respectively.* — DEL GUERCIO, in *L'Agricoltura Coloniale*, Year XL, 1st. Half-Year, No. 2, pp. 65-102 + 35 Figs. Florence, 1918.

A morpho-biological description is given of the larvae and in two cases, also the pupae, of several diptera belonging to the *Cecidomyiidae* family which live on *Olea chrysophylla* in Eritrea and *O. europaea* in Italy. The injury done by the larvae to the respective host plants is also described. The determination of the diptera — described as species new to science — is based, in the absence of adults, on the characters of the larvae examined.

1) *Rhabdophaga cleiporda* n. sp.; attacks young branches of *O. chrysophylla*. The branches are deformed by the galls caused by the larvae, their growth stops, their leaves drop, and eventually they die. If death does not occur the branches remain sterile. The pupa is described. The larva is attacked by an ectoparasitic chalcid, which seems very valuable in the natural control of this insect.

2) *Hormomyia oleiphila* n. sp. The galls produced by the larva develop on the leaves of *O. chrysophylla* and, more rarely, on the extremity of the petiole. The growth of the leaves is stopped, or is so limited that they hardly surround the diseased part with a small border of blade, or the leaf is reduced merely to the portion occupied by the gall. The leaf surface is thus reduced with corresponding injury to the vegetative system and a relative decrease in the yield of the plant. The pupa of this dipteran is also known. The larva may be controlled effectively with an ectoparasitic chalcid.

3) *Radulella aureocephala* n. sp. The larva of this insect causes the formation of very prominent galls on both sides of the leaves of *O. chrysophylla*. It does not appear to be as important as the two preceding insects, especially the first.

4) *Perrisia chrysophyllae* n. sp. Leaf galls are formed on *O. chry-*

*oleiperda*. In economic importance this insect comes after *Rhabdophaga oleiperda*; to judge by the few leaves examined by the author, when they are attacked they are reduced to about half their normal size.

5) *P. proxima* n. sp. Leaf galls are formed on *O. chrysophylla* causing a marked reduction of the leaves attacked; this reduction is less marked when the petiole is diseased. The economic importance of the insect is equal to that of the preceding one.

6) *P. verrucosa* n. sp. The leaf galls formed on *O. chrysophylla* are similar to those caused by *P. proxima*.

7) *Lasiöptera carpophila* n. sp. The larva is described from a specimen found in fruit of *O. europaea* from the province of Teramo. A larva probably identical with the preceding one has been observed in olives from Promontorio Garganico.

The author takes *Dasineura luthierei* and *Lasiöptera kiefferiana*, which in Italy attack the vegetative and reproductive organs of *O. europaea*, as types of two new genera which he calls *Gioliella luthierei* and *Gastinella kiefferiana* respectively.

The most important preventative control measure for some of these insects is to prevent their passing from one continent or district to another or attacked produce. Although it has not yet been proved experimentally that *Rhabd. oleiperda*, peculiar to *O. chrysophylla*, can also attack the common olive, the mere possibility is sufficient to justify the above precaution until the contrary has been proved. The same applies to *Gioliella luthierei* and *Gastinella kiefferiana*, so that they may not be carried from Lake Major and the unredeemed lands to central and southern Italy.

When the species of diptera described are already very common, the easiest, best, and most economical way of preventing their spreading and to cure attacked plants is by suitable pruning or topping of the diseased branches. All the parts cut should be immediately burnt. As topping prevents harvest in the year in which it is carried out it is best to prune, whether the plants be small or fairly large, and to spray abundantly with lime water, calcium polysulphide, or lime sulphur mixture, using these liquids alone, or, better still, together with a certain amount of flour, even if damaged, as it makes the mixture more adhesive.

946 - *Hoplia floridana* n. sp., a Coleopteron Injurious to Citrus, in Florida. —

FISHER, W. S., in *The Canadian Entomologist*, Vol. L. No. 4, pp. 140-142. London, April, 1918.

Under the name of *Hoplia floridana* a description is given of a coleopteron (fam. *Scarabacidae*) collected at Lake Wales, Florida, by Mr. H. L. DOZIER on February 7, 1917; it is described as new to science. The five specimens, two males and three females, found up to the present were taken while feeding on citrus foliage.

947 - *Nezara viridula*, a Hemipteron Injurious to Pecan Trees in Georgia, U. S. A. — See No. 927 of this Review.

948'— *Evetria buoliana*, a Microlepidopteron Injurious to Pines in France —  
LÉVÊQUE DE VILMORIN, FIT., in the *Bulletin de la Société de Pathologie végétale de France*,  
Vol. IV, Pt. 2, pp. 83-85. Paris, 1917.

For many years the pines of Verrières have suffered from attacks of *Evetria buoliana* Schiff., which destroys a considerable number of buds and deforms the trees to such an extent that they are absolutely unrecognizable. Young trees are particularly attacked.

The microlepidopteron (fam. *Tortricidae*) was described for the first time in 1776, in Austria, and is known in Europe, where, of recent years, notes on it have been published by various authors, amongst them BARBEY, LÉSNÉ and TRINCHIERI.

In the summer of 1914 it was reported for the first time in different parts of the United States, where it was probably introduced accidentally on young pines imported from Europe. In order to prevent its being again introduced, the American Government, by its Quarantine Order No. 29 of March 1, 1915, which came into force on July 1, 1915, forbade the importation of all varieties of pine of European origin.

At Verrières *P. ponderosa*, *P. ponderosa* var. *Malletii*, *P. Sabiniana*, *P. Taeda*, *P. contorta*, *P. muricata* are seriously injured, and some specimens have been completely killed by the repeated attacks of the insect.

*P. Thunbergii*, *P. Wilsonii*, *P. Coulteri*, *P. Jeffreyi*, *P. yunnanensis*, *P. uncinata*, *P. Balfouriana*, *P. Pinaster*, *P. monophylla*, *P. leiophylla* and many others are also attacked, but less severely.

The only specimens of *P. sylvestris*, *P. Laricio* and *P. Laricio* var. *auritiaca* are old and strong, and the damage could not be ascertained.

On the other hand, a series of 5-leaved pines, represented at Verrières by *P. Armandi*, *P. Ayacahuite*, *P. Cembra*, *P. excelsa*, *P. koraiensis*, *P. monticola*, *P. parviflora*, *P. pentaphylla*, *P. Peuce* and *P. Strobilus* has, so far, proved immune.

The fine pine from northern China, *P. Bungeana*, is also free from attack, as is a fairly strong specimen of *P. sylvestris* var. *rigensis*, and another of *P. rigida*.

The insect pupates in a gallery hollowed within the bud, in the first fortnight of June, and the moths appear at the end of June or beginning of July. Attacked buds which were placed in a breeding cage on June 1, 1915, gave moths on June 5. In 1917, nearly all the larvae pupated on June 11, and the first moths emerged on June 26. The author found a parasitised pupa, the body of which was filled with a large number of small larvae.

The only method of control seems to be the collection and destruction of infected buds containing larvae or pupae. Nevertheless, although this method has been adopted carefully for many years at Verrières, the ravages of the insect continue to increase. It might be possible to utilise several species of ichneumons, parasites of the larvae of *Evetria*, the presence of which was first observed in 1917 at Verrières. M. LÉSNÉ advises that attacked buds should be collected towards the beginning of June, and that, instead of burning them, they should be enclosed in vessels covered

with a fine mesh metallic net which will prevent the escape of the moths, but not that of their parasites.

#### INJURIOUS VERTEBRATES.

149—**The Control of Field Mice by Acetylene Gas.**—ΠΑΠΑΓΕΩΡΓΙΟΥ ΠΗΛ.  
(PAPAGEORGIOU, P.) in ΓΕΩΡΓΙΚΟΝ ΔΕΛΤΙΟΝ ΤΗΣ Β. ΓΕΩΡΙΚΗΣ  
ΕΤΑΙΡΕΙΑΣ (*Bulletin of the Royal Hellenic Society of Agriculture*), Vol. X, No. 111,  
pp. 3179-3182 + 1 Fig. Athens, 1918.

The author reports the very satisfactory results obtained by him at the Agricultural Station of Thessaly with a new acetylene gas method for destroying field mice. In many parts of the vast cereal-producing plain of Thessaly field mice, aided by favourable conditions, have multiplied so considerably that they are a serious menace to the coming harvest. In the absence of other chemical products, such as strychnine, carbon bisulphide, etc., the author applied calcium carbide, produced in large quantities by a local firm working a water fall at Gorgopotamos, near Lamia. Small pieces of calcium carbide the size of a pea are placed in the holes dug by the mice, a little water poured in and the holes stopped up. The mice are suffocated by the gas. If new holes open in two or three days the procedure is repeated. The method is harmless to those using it, easy to apply, and cheap.

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FIRST PART.  
ORIGINAL ARTICLES

**Mechanical Ploughing.**

**Methods of Ploughing without Ridges**

by

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The most important factors controlling the yield from a machine plough are the way the land is set out and the choice of the most suitable method of ploughing.

As is well known there are two systems of ploughing — ploughing with or without ridges (1).

PLOUGHING WITHOUT RIDGES.

In this method the furrow-slices are turned always to one side and no open furrows are left, thus facilitating work with harrows, drills, binders, etc., but requiring good well-drained soil. It can be performed in two ways :—

1) The *ordinary method* (the most used in Europe) consists in successively turning parallel furrows, by moving backwards and forwards be-

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(1) Hilling-up (used for maize and other hoed crops) can be considered as a derivation of both the above-mentioned systems, rather than as a special method, as it first requires the land to be worked uniformly, the hills being thrown up afterwards, usually with double-breasted ploughs.

tween the headlands. It is also practised on hilly land, as the furrows can all be thrown down-hill. It requires ploughs that can alternately turn the soil to the right (going) and left (returning) as with one-way, balance, and double Brabant ploughs.

2) *The Felleberg method* requires uninterrupted furrows, obtained by keeping the plough turning continually in the field, either from the headlands towards the centre or vice versa. With this method there are thus curved furrows at the corners of the field, therefore leaving small triangular areas unploughed. It evidently necessitates the use of the common single-breasted plough (turning either to the right or left) as in the ordinary motor- or traction-ploughs.

The same type of plough can be used for making ridges, either by gathering-up or casting. This method is too well known to necessitate a description, but, on account of its importance, it will be considered later.

1) **ORDINARY PLOUGHING WITHOUT RIDGES.** — This can be done on land of any shape or size and requires no special setting-out of the land, but the following precautions should be observed: —

a) The furrows should be turned parallel to the longest side of the field, to reduce the number of turns at the headland. However, it may be better to sacrifice the long furrow for the advantage of having the

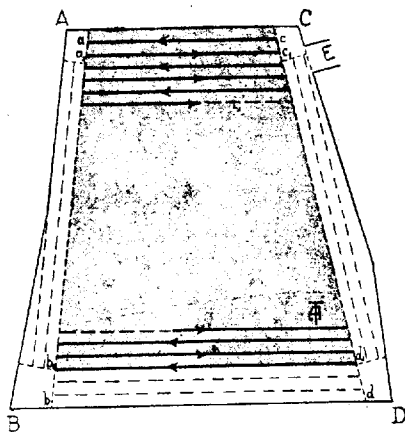


Fig. 1. — Furrows between two parallel sides of an irregular field.

furrows between two regular and parallel sides, as in Fig. 1, so as not to leave wedge-shaped pieces that would have to be finished with a team or by hand.

b) In this case it is best not to carry the furrows up to the irregular lines  $AB$ - $CD$  of the other ends of the field, but rather to stop them on the rectilinear line  $ab$ - $cd$ , so that the work will be easier to finish, either with a team or with the machine itself.

c) The entrance into the field should never (as in any system of ploughing whatever) be forgotten, and the order of the work should be subordinated to it so that, when the work is finished, the machine does not need to pass over the ploughed ground. Thus in the case of Fig. 1, where  $E$  is the entrance to the field, the ploughing will be commenced at  $ac$ ,  $a, c, \dots$  up to  $b, d$ , that is, at such a distance from  $BD$  as will allow the machine or the team to pass to finish the headland  $b, d$ - $BD$ . Afterwards, the headland  $ab$ - $AB$  is first ploughed, then the strip  $b, d$ , -  $bd$  and finally the headland  $cd$ - $CD$ , the machine leaving the field at the entrance  $E$ .

By ploughing without ridges, the whole of the field can be ploughed, save the small areas at the ends of the headlands necessary for the machine to turn in, proportional to the width of the headlands (1) and which are worked by hand.

When balance ploughs are used the width of the headland is approximately equal to the distance between the two extreme, opposite ploughs. In the case of turnwrest ploughs and double-Brabants, it depends on the breadth of the always-necessary *double, or figure-of-8, turns* that the machine can take, providing that it is not a question of machines with a central gripping-drum, which, up to a certain point, can turn on themselves.

2) FELLEMBERG PLOUGHING. — As is well known, it is difficult to turn perfect furrows on a curve so that this system is not advisable in all our soils (in Italy) where the ploughing is usually heavy and deep, the earth being turned over as evenly as possible.

On the other hand this system is much used in America where the large regular spaces, the friable, light soils, and the shallow ploughing, give a certain liberty as regards beginning ploughing, and where rapid work together with the maximum yield from the machine are required rather than regular and perfect ploughing.

With this system the time lost in turning when not working is certainly at a minimum (theoretically it should be nil), as the fatigue caused by turning when working is also minimised, but, on the contrary, very large triangular plots (the size of which increases with the size of the field and the acuteness of the angle) are left in the corners of the field, thus necessitating their being worked with a team or by hand, or even, if so desired, with the machine, but with a great loss of time.

(1) The headlands are best not ploughed with cable-hauled machines, but rather with a team. But if this is required a free strip should be left along  $AC$ , so that the machine can leave the field with the anchors or anchor-waggon, etc.